AGRICULTURAL RESEARCH INSTITUTE

PUSA

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

CHARLES C. BABINGTON, Esq., M.A., F.R.S., F.L.S., F.G.S.
JOHN EDWARD GRAY, Ph.D., F.R.S., F.L.S., F.Z.S. &c.,
WILLIAM S. DALLAS, F.L.S.,

AND

WILLIAM FRANCIS, Ph.D., F.L.S.

VOL. XIII.—FOURTH SERIES.

LONDON:

PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.

SOLD BY LONGMANS, GREEN, READER, AND DYER; SIMPKIN, MARSHALL, AND CO., KENT AND CO; WHITTAKER AND CO. BAILLIÈRE, PARIS: MACLACHLAN AND STEWART, EDINBURGH: HODGES, FOSTER, AND CO., DUBLIN: AND ASHER, BERLIN.

1874.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons, from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet, the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where still waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

CONTENTS OF VOL. XIII.

[FOURTH SERIES.]

NUMBER LXXIII.

NUMBER LXXIV.

NUMBER LXXVIII.

PLATES IN VOL. XIII.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

". . . . per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 73. JANUARY 1874.

I.—*Notice of a new Species of Deer from the Norfolk Forest-Bed.* By RANDALL JOHNSON, Esq.

[Plate I.]

It is well known that the Forest-bed which runs along the Norfolk coast abounds in mammalian remains of various species. Amongst these the remains of Cervidæ are largely represented; but they have not until lately received from palæontologists the attention so deservedly due to them. It would not, however, be right to omit to mention the labours of Dr. Falconer, who turned his attention to the Forest-bed fauna during the later years of his life, of the Rev. John Gunn, of Irstead, Norfolk, and, more recently, of Mr. Boyd Dawkins, all of whom have contributed to extend our knowledge on this subject. Among the many remarkable species found in this deposit there is one which is certainly new to Britain, and, so far as I am able to ascertain, one that has not been found in any deposit of corresponding age with the Forest-bed on the continent. This new form is represented by the left antler and a portion of the left frontal bone, which I had the good fortune to obtain myself from the Forest-bed at Hasbro, a

small village on the Norfolk coast between Cromer and Yarmouth, after a very low tide, during the month of March last. Mr. Gunn informs me that it is the upper portion of the Forest-bed which is exposed at the above-mentioned place, and consequently we may consider it of later date than that portion found near Cromer.

The species in question belongs to the large subgenus of palmated deer of which *Cervus megaceros*, the so-called Irish Elk, is a well-known example; and as it is characterized by the great breadth of the frontal bone, I propose to name it *Cervus latifrons*. In addition to this, the chief characteristics which this remarkable form presents are as follows:—the extreme shortness of the pedicle, if a pedicle can really be said to exist at all; the absence of a brow-antler, the beam of the antler being given off from the frontal bone nearly at right angles, with a slight curvature downwards, while at about the distance of twelve inches from the burr palmation commences and a huge tine is given off from the anterior surface of the beam, which curves round so as to form almost a semicircle. This tine, when compared with the size of the beam, will be found to be very largely developed.

If we compare this antler, possessing the above-named characteristics, with that of *Cervus megaceros*, to which the species in many respects is nearly allied (notably in its palmation and size), we shall find that there are considerable differences. *Cervus megaceros* always possesses a brow-antler, although sometimes but faintly indicated; in the new species we have seen that it is entirely absent. Again, in *Cervus megaceros* there is a great curvature of the beam outwards and in a certain degree upwards, whereas in *Cervus latifrons* the beam is extremely straight and with only the slightest trace of a downward curvature. Besides the differences which exist between the antlers of the two species, one would naturally expect to find differences in other portions of the skeleton; and that there are such is shown by the only portion I possess, viz. the left frontal bone before mentioned. In *Cervus megaceros*, if we look at the anterior part of the frontal bone we immediately notice that it is very narrow and rather convex, while in *Cervus latifrons* it is very broad and nearly flat.

The annexed drawing (Pl. I.), one fourth the natural size, will give an approximate idea of the specimen, the measurements of which I give together with those of another larger (but more imperfect) specimen of the same species, which is preserved in the Norwich Museum.

	Specimen figured. inches.	Specimen in Norwich Museum. inches.
Extreme length	$19\frac{1}{8}$	21
Circumference in centre of beam	$7\frac{3}{4}$	$8\frac{3}{4}$
Length from burr to commencement of palmation	12	16
Length from midfrontal suture along curve to end of first tine	37	

Associated in the Forest-bed with *Cervus latifrons* there are found several other species of Cervidæ, which it may be interesting to mention. Of these some are peculiar to the Forest-bed, while others are common to the Forest-bed and other deposits of Pleistocene and Pliocene age both in England and on the continent. The following is a list of the species that have as yet been clearly determined :—

Cervus elaphus.	*Cervus Sedgwickii.*
—— *capreolus.*	—— *latifrons*, n. sp.
—— *megaceros.*	—— *Carnutorum.*
—— *martialis.*	—— *Polignacus.*
—— *verticornis.*	

Of the nine species enumerated above two only have lived down to our own times, viz. the Stag (*Cervus elaphus*) and the Roebuck (*Cervus capreolus*). These two, together with *Cervus megaceros*, have not been found in strata of Pliocene age, and therefore, as Mr. Boyd Dawkins justly observes (Quart. Journ. Geol. Soc. Nov. 1, 1872, p. 410), "point rather forwards than backwards in time." *Cervus martialis*—a species with subcompressed ramified antlers, hitherto unmentioned in lists of Forest-bed Cervidæ, and closely allied to the Reindeer (*Cervus tarandus*)—leads us to draw the same conclusion, as it has been found in the Postpliocene sands of Riège, near Pezenas (*cf.* Gervais, 'Zoologie et Paléontologie Française,' p. 144). Of the remaining species, *Cervus verticornis* (rivalling *C. megaceros* in size and characterized by the downward and outward curvature of the brow-antler), *Cervus Sedgwickii* (a remarkable form with compressed antlers, described by Dr. Falconer, 'Palæontographical Memoirs,' vol. ii. p. 471), and *Cervus latifrons* have as yet been found only in the Forest-bed. *Cervus Carnutorum* and *C. Polignacus* are Pliocene forms, the former having been found in the Pliocene deposit of St. Prest, near Chartres, by M. Laugel, and the latter also in a Pliocene deposit at Mont Perrier, near Issoire, and figured by Croizet and Joubert.

The Forest-bed Cervidæ taken as a whole, although composed of a remarkable and peculiar assemblage of forms, show us, as has been pointed out by Mr. Boyd Dawkins in the valuable paper above mentioned, that the Forest-bed itself is rather of Pleistocene than Pliocene age; and as we know that *Elephas primigenius*, *E. antiquus*, and *Bison priscus*, all Pleistocene forms, are numbered amongst its fauna, we are justly entitled to consider that the data are such as warrant the above conclusion.

II.—*On the Affinities of the Genus* Stromatopora, *with Descriptions of two new Species*. By H. Alleyne Nicholson, M.D., D.Sc., M.A., F.R.S.E., Professor of Natural History in University College, Toronto.

In the 'Annals' for August 1873 I described four species of *Stromatopora* (one from the Upper Silurian, and three from the Devonian rocks of Canada), all of which exhibited certain relationships with the Spongida. As regards two of the species described in the paper alluded to, I have now obtained some further material, by which certain interesting points of structure are brought out, and the reference of these fossils to the Spongida is still more clearly established. I have also to describe for the first time two new and exceedingly interesting species of the genus—one from the Corniferous Limestone (Devonian), and the other from the Niagara Limestone (Upper Silurian). In the first place, however, it may be as well to discuss briefly the systematic position of the genus *Stromatopora*.

The genus *Stromatopora* of De Blainville includes a number of fossils of doubtful affinities, which have the common character of forming amorphous masses or irregular expansions, composed of delicate calcareous laminæ, arranged in successive strata one above the other, and separated from one another by minute vertical props, pillars, or dissepiments. Very often the successive laminæ are disposed round an imaginary centre or centres in a concentric manner, giving rise to spherical, hemispherical, or irregularly massive forms. In other cases the mass * is extended so as to form an expanded cup or irregular

* I would suggest that the term "sarcodeme" (Gr. *sarx*, flesh; *dēmos*, people) might advantageously be employed to designate the entire organism or colony amongst the compound Foraminifera and the Sponges. Some such term is certainly needed in treating of such problematical organisms as *Stromatopora*, of which the exact systematic position is doubtful.

sheet, made up, like the preceding, of successively superimposed laminæ.

The main element, therefore, in the structure of *Stromatopora*, and the only one about which all observers are tolerably agreed, is a system of parallel calcareous laminæ, generally of great tenuity, not in actual contact, but separated from one another by narrow interspaces. The successive laminæ are kept apart by a vertical system of calcareous pillars, which divide the interspaces between the laminæ into minute, usually quadrangular compartments, and thus render the whole mass more or less minutely vesicular.

So far, the structure of *Stromatopora* would be compatible with a reference of the genus either to the Foraminifera or the Spongida; but there are unfortunately many differences of opinion as to the further structure of these fossils, and these have led to equally wide differences of opinion as to the affinities and systematic position of the genus.

According to M'Coy (Pal. Foss. p. 12) the vesicular tissue of *Stromatopora* is composed of "minute, curved, calcareous plates," which he compares to the cœnenchyma of *Palæopora* and *Fistulipora*. He also states that the upper surface is occasionally marked "with extremely obscure, distant, quincuncially arranged, small pits," which he appears to think may represent the corallites in the above-mentioned or other allied genera.

Prof. Hall agrees with M'Coy in referring *Stromatopora* to the Cœlenterata, and in placing it in the neighbourhood of *Tubipora* (Pal. N. Y. vol. ii. p. 135). He considers that the fossils of this genus are composed of "minute cylindrical tubes with considerable space between, and that the laminated structure arises from thin layers of calcareous matter, deposited and filling the spaces between, and enclosing the tubes."

My own investigations of a very extensive series of specimens from the Lower and Upper Silurian rocks and from the Devonian Formation have led me to the conclusion that the genus *Stromatopora* is clearly referable to the Spongida, and that it should be placed amongst the Calcispongiæ, a group represented by many and varied forms both in past time and at the present day. The reasons for this belief may be shortly summed up as follows:—

a. The fundamental structure of *Stromatopora* is by no means inconsistent with the belief that it belongs to the calcareous sponges. It does not consist of reticulated calcareous spicula, as in the more typical members of the group; but neither does it consist of a vesicular tissue composed of "minute curved calcareous plates" (M'Coy), which could be in any way

compared to the vesicular cœnenchyma of many tabulate corals. On the contrary, it consists of successive calcareous layers which may be regarded as composed of an amalgamated system of horizontal spicules, separated by interspaces, and kept apart by a vertical system of delicate calcareous rods, giving rise to a system of more or less quadrangular cells. The horizontal laminæ are upon the whole continuous; but they sometimes subdivide and inosculate; and the vertical pillars are decidedly irregular, being sometimes inclined at various angles, and not being placed at uniform distances apart even in all portions of a single specimen. Some of the vertical rods appear to pass continuously through several laminæ and across the interspaces between them; but the greater number are confined entirely to the interval between two successive laminæ, not being continuous or corresponding with those in the interspace immediately above or below. There is no ground, so far as I am aware, for believing that these vertical pillars or rods are perforated, or could possibly be of the nature of tubes inhabited by the separate zooids of a colony; on the contrary, in all the forms which have come under my notice, there is the strongest possible proof that they are solid and imperforate. There is thus nothing in the fundamental tissue or groundwork of *Stromatopora*, as above described, which would necessarily preclude us from referring the genus to the Spongida; nor can any stress be laid upon Prof. M'Coy's argument that these organisms cannot be sponges on account of their possessing a rigid and inflexible skeleton, since similar reasoning would compel us to remove from the Spongida a vast number of forms the zoological position of which is beyond doubt. At the same time, if *Stromatopora* consisted wholly of the laminated and reticulated tissue above described, and possessed none of those openings which are so characteristic of the Sponges, then indeed the genus might be more properly referred to the Foraminifera, the near allies of the Sponges in some respects, but destitute of the canal-system which is present in the latter.

b. Such openings, however, can be shown to exist in certain forms of *Stromatopora*; and there is strong reason for believing that they will ultimately be found to be present in all. Thus in *S. striatella*, D'Orb., and *S. concentrica*, Goldf., both typical examples of the genus, Prof. M'Coy long since described the existence of vermicular tubes opening on the surface by small apertures, and passing more or less vertically through the component layers of the mass (Pal. Foss. pp. 14 & 15). There is some ambiguity in the language used by this eminent palæontologist in describing these tubes and their

openings in *S. concentrica*; and the evidence is not at present sufficient to warrant any positive statement of opinion as to whether they may correspond with the "pores" or the "oscula" of an ordinary sponge. It is probable, however, that they should be regarded as representing the "pores," and that the "oscula" will yet be discovered by a more extended and complete examination. Again, in *S. ostiolata*, Nich., a species from the Guelph formation of Canada, the upper surface of the mass exhibits small but regularly arranged openings, which, from their remoteness and general form, can hardly be regarded as other than "oscula" ('Annals,' Aug. 1873, pl. iv. fig. 1). In *S. tuberculata*, Nich., again, I have now discovered a system of comparatively large and remote openings, which communicate with canals traversing the organism, and which appear to fulfil beyond all question the function of exhalant apertures. In *S. granulata*, Nich., no openings are ordinarily to be detected, probably on account of the manner in which specimens are generally preserved; but I have one example showing both small and large openings, which must be considered as being inhalant and exhalant. In *S. perforata*, Nich., now described for the first time, the entire mass, or "sarcodeme," is traversed by numerous and close-set canals of considerable size, which open at the surface in rounded apertures generally placed on conical or chimney-like eminences. These must represent exhalant canals and apertures. Lastly, in *S. Hindei*, also now described for the first time, there is a series of small close-set apertures which must represent "pores," and another series of larger, more remote, and more irregularly disposed openings which can only be regarded as oscula. With the exception, however, of the last-named species and of the single specimen of *S. granulata* above alluded to, I am acquainted with no species of *Stromatopora* which has hitherto been shown with certainty to possess *two* sets of openings—one small and inhalant, the other large and exhalant. It must be remembered in this connexion that the difficulties in the way of observation are in this case extremely great, since the condition of mineralization in which these fossils occur is generally such that the cavities of the mass are filled up with foreign material, whilst the reticulated tissue itself is often silicified. Hence it would be easy for such minute surface-apertures as the "pores" of a sponge to be irrecognizably filled up and obliterated or to escape detection.

c. The shape of the various species of *Stromatopora* is such as would accord perfectly well with the belief that the genus is referable to the Spongida. Some species are in the form of rounded or irregularly hemispheric or conical masses. Others

are somewhat cup-shaped; and others, again, have the form of irregular and extended crusts, apparently attached at one point to some solid body, from which they spread laterally in every direction, or seem to form incrusting sheets.

Upon the whole, I think the evidence is very decidedly in favour of the view that the genus *Stromatopora* is referable to the Calcispongiæ. In accordance with this view, I retain in this genus the forms which I have named *S. tuberculata*, *S. granulata*, *S. perforata*, and *S. Hindei*, since these are undoubted sponges, and would upon any other view of the affinities of *Stromatopora* require to have a new genus formed for their reception.

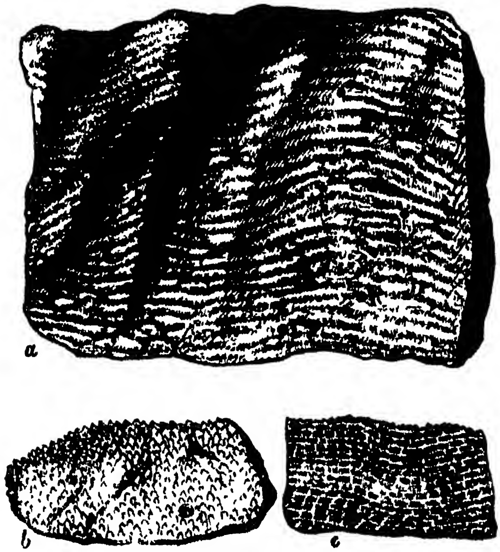
1. *Stromatopora tuberculata*, Nicholson.

Stromatopora tuberculata, Nicholson, Ann. & Mag. Nat. Hist., Aug. 1873, pl. iv. figs. 2, 2 *a*.

Having now obtained a considerable number of additional specimens of this species, I have to add two observations of importance to my original description. In the first place, I have now obtained specimens showing that the under surface of the expansions of *S. tuberculata* is covered by a thin calcareous basement-layer, which is thrown into very numerous concentrically arranged undulating wrinkles. This surface thus presents somewhat the appearance of the epitheca of a *Favosites*; but it is much thinner and rougher, and is pierced by apertures. In the second place, both the upper and the lower surface exhibit at irregular intervals rounded apertures which are placed at distances apart of from two lines to half an inch, and have a diameter of from half a line to two-thirds of a line. These apertures are wanting in some specimens, which, however, are but fragmentary, whilst they can readily be detected in others. They are the openings of canals which penetrate the mass in a more or less vertical direction; and I noticed their occurrence in my original description of the species, though I did not at that time fully recognize their nature. The case was thus stated by me:—"Many examples exhibit rounded openings or tubes, from half a line to a line in diameter, descending at right angles to the mass, and placed at varying intervals. These openings are not elevated above the general surface. They are not constant in their occurrence, though very generally present; and I have not been able to satisfy myself that they are not truly extraneous to the fossil. They may, perhaps, be annelidous in their nature; or they may be due to the fact that the organism has enveloped a colony of *Syringopora*, which has subsequently been dis-

solved away" (*loc. cit.* p. 93). The materials now in my hands, however, are quite sufficient to prove conclusively that

Fig. 1.



a, part of the under surface of a large example of *Stromatopora tuberculata*, showing the concentrically wrinkled basement-layer and the openings of the oscula, natural size. *b*, a portion of the upper surface, natural size; *c*, a vertical section of a fragment of the same, magnified to show the internal structure.

these canals and apertures are truly parts of the fossil. They are mostly to be detected upon the upper surface of the mass; but in one large specimen, which seems to have grown from a broad base of attachment and then to have spread out laterally in an irregularly cup-shaped form, they are plentifully developed on the lower surface. It can hardly be that they can be any thing else than openings corresponding to the "oscula" of sponges. The "pores" I have not yet made out with absolute certainty; but I believe that the surface-tubercles are truly of this nature, some of them showing almost conclusive proofs of having been perforated by minute openings at their apices.

There would thus appear to be every reason for concluding that *S. tuberculata* is truly a calcareous sponge; and the chief question remaining is whether it can with propriety be re-

tained in the genus *Stromatopora*. My own opinion is decidedly against forming a new genus for its reception, since it has the essential structure of *Stromatopora*; and the difficulty which I experienced at first in detecting the oscula, even in the examination of a large series of specimens, has convinced me that the occurrence of similar openings may well have been overlooked, even in the type species of the genus.

2. *Stromatopora granulata*, Nicholson.

Stromatopora granulata, Nicholson, Ann. & Mag. Nat. Hist., Aug. 1873, pl. iv. figs. 3, 3 *a*.

The specimens upon which my original description of this species (*loc. cit.* p. 94) was founded were all from the Corniferous Limestone; and I failed to detect in them any traces of apertures which could be regarded as either pores or oscula. Recently, however, I have obtained an example of *S. granulata* from the Hamilton group of the township of Bosanquet, showing both these sets of apertures; and I have also obtained additional specimens from the Corniferous Limestone showing the under surface and the mode of growth.

The first of the above-mentioned specimens is only a fragment; and its greater portion exhibits all the appearances which characterize the Corniferous examples of the species. The upper surface of the fossil exhibits several rounded or conical elevations, one of which is perforated by a large subcircular aperture leading down into the interior, and evidently of the nature of an osculum. Whether the other elevations were similarly perforated or not does not clearly appear. The pores are only shown over a small portion of the fossil, and have the form of minute close-set perforations in a delicate calcareous membrane or surface-layer. Beneath this layer, and over all parts of the specimen whence it has been denuded, is seen the ordinary granulated surface from which the name of the species was originally derived. There is thus a probability established that all the specimens from the Corniferous Limestone which exhibit simply this granulated surface are imperfect, and that there has been removed from them an exterior and very delicate membrane in which the pores were pierced. The granulated layer which appears to form the surface in so many specimens would seem on this view to have served the purpose of distributing the water received through the external poriferous layer, the granules with which it is studded being more or less confluent, and giving rise to a complicated system of sinuous or vermicular horizontal channels.

The under surface of *S. granulata* is covered by a thin, con-

centrically wrinkled calcareous membrane, precisely similar to the epitheca of a *Favosites* or *Fistulipora*. Usually the species forms extensive crusts of no great thickness; but I have one specimen in which the organism is attached by a broad base to a large *Heliophyllum*, from which it spreads out laterally in all directions as a horizontal expansion, the under surface being covered with a wrinkled "epitheca," and having been obviously free.

3. *Stromatopora perforata*, Nicholson.

Spec. char. Fossil composed of crusts of varying thickness, made up of thin concentrically arranged calcareous laminæ, the interspaces between which are rendered vesicular by vertically disposed calcareous rods or dissepiments. From four to five laminæ with their intervening interspaces occupy the space of one line. Upper surface undulating, and covered with very numerous rounded apertures, which vary in width from two thirds of a line to one line, and are situated at distances apart of a line, more or less. These apertures are usually placed at the summit or on one side of conical eminences; or they are elevated above the general surface, the margin of the opening on one side being in general higher than on the other. These apertures are the orifices of vertical or somewhat oblique canals, which penetrate the vesicular tissue of the fossil, and are lined with a delicate calcareous membrane, marked with faint encircling striæ. For a certain distance (two or three lines) each canal descends in a straight line, and then is curved so as to become nearly parallel to the lower surface of the mass, at the same time contracting in its diameter (fig. 2, *c*). Between the oscula, as just described, the surface is covered with a fine miliary granulation, composed of minute pustules placed close together and arranged in irregular vermicular or sinuous lines.

Stromatopora perforata is perhaps the most remarkable species of the genus which has been yet described; and it cannot be doubted that it is a genuine member of the Calcispongiæ, though in some respects an abnormal one. In its internal structure it agrees altogether with *S. tuberculata*, *S. granulata*, and *S. mammillata*; and with the two former of these it agrees further in the possession of a series of apertures which cannot be any thing but "oscula." No "pores," however, have been detected, unless some of the surface-tubercles should in reality be perforated, which is likely enough.

S. perforata is readily distinguished from *S. tuberculata* by the much greater number and closer arrangement of the oscula, by the elevation of these apertures above the general surface,

and by the finer and more minute character of the surface-granulation. The number and closeness of the oscula also

Fig 2.

Stromatopora perforata: *a*, a fragment, showing the osculiferous upper surface, natural size; *b*, a fragment magnified, to show the internal structure; *c*, vertical section of a fragment, showing the form and course of the canals, natural size.

separate this form from *S. granulata*, in which the oscula are remote, and often cannot be detected at all, though in other respects the surface-characters of the two are very similar or even identical. The under surface of *S. perforata* is still unknown; but the fossil forms thinner or thicker crusts, often covering pretty extensive surfaces, the thicker expansions being composed of a succession of crusts superimposed one upon the other.

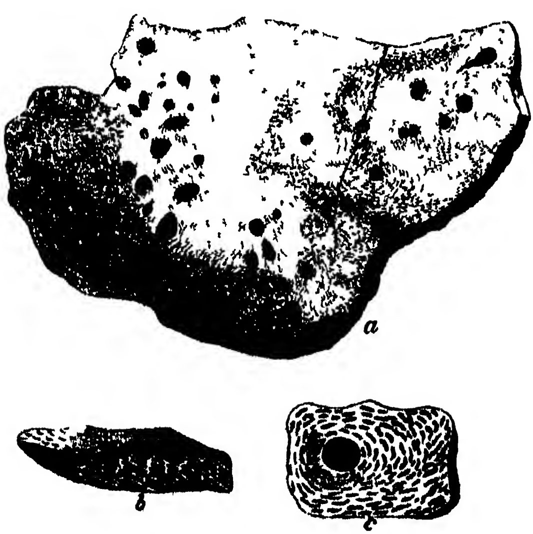
Locality and Formation.—Rare in the Corniferous Limestone of Port Colborne. Collected by the author.

4. *Stromatopora Hindei*, Nicholson.

Fossil forming thin crusts or subhemispheric masses composed of successive concentrically disposed strata, each stratum made up of parallel calcareous laminæ separated by interspaces. Sometimes the component laminæ of each stratum are parallel with the upper and lower surfaces of the stratum or nearly so; but more commonly they are oblique to these surfaces. The result of this is that the interspaces between the laminæ open on the surfaces of each stratum as so many elongated and oblique apertures, which have usually the form of fissure-like sinuous slits, but sometimes present the appearance seen in weathered specimens of *Alveolites*. The laminæ of each stra-

tum are sometimes connected by transverse pillars, but more commonly they are so bent and curved as to inosculate with one another at points closely approximated, thus giving the whole mass a vesicular structure. Well preserved specimens show about eight laminæ in the space of one line. The upper surface of the fossil exhibits not only the linear and vermicular openings above spoken of as produced by the interlaminar spaces, but also a series of large rounded or oval openings, which are more or less irregularly disposed, and which are the orifices of so many canals which penetrate the mass vertically or obliquely. The size of these oscular apertures varies; but most of them have a diameter of from a line to a line and a half. They also vary greatly in their number in a given space, some fragments exhibiting many of them placed close together, whilst others only show a few, and these remote. The walls of the canals leading away from these openings are not lined by a continuous calcareous membrane (as in *S. perforata*), but are perforated like a sieve by the elongated slits

Fig 3



Stromatopora Hindei, **Nich.: *a*, upper surface of a fragment, natural size, showing the pores and oscula; *b*, vertical section of a fragment, enlarged, showing the obliquely arranged laminæ and interlaminar spaces; *c*, upper surface of a fragment, enlarged.**

produced by their intersection with the interlaminar spaces. Lastly, the general surface is undulating, and the oscula are not elevated upon eminences or papillæ.

This remarkable species departs in some important respects from the structure of the typical species of *Stromatopora*; but it presents at the same time such a close resemblance to forms like *S. tuberculata* that it does not seem necessary to form a new genus for its reception. The chief peculiarity of the present form depends upon the fact that the component laminæ of the mass are not arranged concentrically as regards the entire mass; but the fossil is composed of concentric layers, each of which is composed of parallel or subparallel laminæ disposed obliquely to the surfaces of the stratum. Hence the interlaminar spaces, instead of being parallel with the surface of the mass (as in *S. tuberculata* and *S. granulata*), open upon the surface in the form of oblique, sinuous, or vermicular openings, sometimes rounded or subtriangular, but more commonly linear and having a transverse diameter of about one hundredth of an inch. It can hardly be doubted that these minute openings, which cover the greater part of the entire surface, are of the nature of inhalant apertures or "pores;" and they communicate to fragments of this fossil very much the aspect of worn and weathered examples of certain forms of *Alveolites* and *Cœnites*. All those portions of the surface which are not occupied by the pores are taken up by very much larger openings, which are certainly exhalant apertures or "oscula." Very often the laminæ are arranged in any given stratum in a subspiral manner round certain points of the mass, and the pores on the surface have a corresponding arrangement.

Upon the whole, little doubt can be entertained as to the propriety of referring this species to the Calcispongiæ; and its structure would strongly corroborate the view that the surface-tubercles in *S. tuberculata* are truly perforated, and are of the nature of pores, though examples of this species as ordinarily preserved do not exhibit this feature clearly. I have named the present species after its discoverer, Mr. George Jennings Hinde, who has kindly furnished me with specimens for examination.

Locality and Formation.—Common in a magnesian limestone of the age of the Niagara Limestone (Upper Silurian), at Owen Sound, Ontario. Collected by Mr. G. J. Hinde.

III.—*On a New* Parascyllium *from Hobson's Bay*. By Frederick M'Coy, Professor of Natural Science in the Melbourne University, and Director of the Melbourne National Museum.

[Plate II.]

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

As only one species of *Parascyllium* is noted in Dr. Günther's Catalogue, I beg to give you a brief description of a different one, not very uncommon near Melbourne.

Parascyllium nuchalis, M'Coy.

Spec. char. Body and fins clouded with two shades of chocolate-brown, with a broad blackish-brown nuchal collar extending from the base of the pectorals to halfway between the eye and the first gill-opening, and two or three very conspicuous large spots of the same dark colour on each of the fins; the whole of the sides and back covered with white spots, smaller and more crowded on the dark nuchal collar; underside of throat and abdomen pale whitish brown. Mouth nearer the extremity of the snout than to the eye.

Length 2 feet 9 inches; snout to anterior edge of orbit 1 inch, to base of pectoral $3\frac{3}{4}$ inches, to origin of ventrals $11\frac{1}{2}$ inches, to origin of first dorsal $14\frac{3}{4}$ inches, of second dorsal $20\frac{1}{2}$ inches, of anal 20 inches, to caudal 25 inches; girth 7 inches.

This beautiful species is adult at the above size, and is easily recognized by its brown-clouded body, dark, wide half collar, and conspicuous round white spots.

IV.—*On the Genera* Tremarctos, *Gervais* (Nearctos, *Gray*), *and* Ælurina, *Gervais* (Ailurogale, *Fitz.*). By Theodore Gill, M.D., Ph.D.

In the 'Annals and Magazine of Natural History' for August 1873 (vol. xii. p. 183) Dr. Gray has differentiated from the genus to which he had formerly referred it (*Helarctos*) the *Ursus ornatus* of Frederick Cuvier, giving to that species the new generic name "*Nearctos*." A distinct subgenus had, however, been long previously proposed for that species by Gervais ('Hist. Nat. des Mammifères,' tome ii. 1855, p. 20), and named by him *Tremarctos*. The name evidently refers to one of the characters mentioned as peculiar—the supra-

condyloid foramen of the humerus, in which it was said to differ from all the other Ursidæ. This group has been adopted as a distinct genus by the author in his 'Arrangement of the Families of Mammals.'

In reference to the statement that the supracondyloid foramen is absent in all other Ursidæ ("qui manque à tous autres Ursidés"), it may be well to recall that it is developed in the humerus of a fossil bear preserved in the palæontological collection of the Museum at Paris, and figured by Cuvier and Blainville (see 'Ostéographie des Mammifères,' *Ursus*, pl. xvii. desc. p. 93); but, as remarked by De Christol and Blainville, that specimen is doubtless exceptional or "monstrous," it being the only one known among hundreds examined exhibiting such a peculiarity. The same bone has been referred to by Dr. John Struthers, in the 'Lancet' (1873, vol. i. pp. 231, 232), in comments upon the hereditary occurrence of a supracondyloid process in Man. Judging by the figure of the humerus of *Tremarctos ornatus* given by Blainville, the supracondyloid foramen appears, however, to be a normal characteristic of that species; but it would be desirable that such supposition should be proved or disproved by the examination of other specimens, and my chief object in this communication is the hope that it may elicit such information.

I venture also to add another reference that has been overlooked by Dr. Gray as well as Dr. Fitzinger. In the 'Proceedings of the Zoological Society of London' for 1867, p. 268, Dr. Gray has proposed a genus *Viverriceps* for several Felidæ, and among them the *Felis planiceps* of Vigors and Horsfield; and in the 'Sitzungsberichte der Akademie der Wissenschaften zu Wien' for 1869 Dr. Fitzinger has based another genus (*Ailurogale*) on the same species. A subgeneric group had, however, long previously been proposed by Prof. Gervais (*op. cit.* p. 87, 1855) for that species, designated "Ailurin" (Latin, *Ælurina*), and distinguished by the double-rooted false molars of the upper jaw. In my 'Arrangement of the Families of Mammals' I have retained both *Ælurina* and *Viverriceps* (restricted) as genera.

V.—*Descriptions of New Genera and Species of* Heteromera, *chiefly from New Zealand and New Caledonia, together with a Revision of the Genus* Hypaulax *and a Description of an allied New Genus from Colombia.* By FREDERICK BATES.

[Continued from vol. xii. p. 485.]

HYPAULAX, mihi, Trans. Ent. Soc. Lond. 1868, p. 259.

Since the time I established this genus, I have assiduously

collected all the species possible, and have especially endeavoured to obtain as large a series as I could of each species. I propose now to give some remarks on the species described by me at that time, as well as to describe others that are new.

Hypaulax marginata and *sinuaticollis*, mihi, *l. c.* p. 261.

These two species appear to be very rare, as I have been able to add but one other example of *marginata*, and not one of *sinuaticollis*, to the solitary example of each on which their descriptions were founded. The two species are extremely close to each other, but are, at present, well distinguished by the characters given. By some strange error, I have given the prothorax of *sinuaticollis* as longer than wide; it is, as well as the entire insect, relatively much narrower in proportion to its length than in *marginata*; the labium is more narrowly and deeply emarginate in front; the space between the palpi narrower and more convex on the face; the mentum is densely hirsute. In both species the mandibles are strongly notched at the apex; the gular furrow is very strong and close to the base of the submentum; the cheek-furrow is deep and curved, extends nearly to the gular furrow, and terminates in a large, subpyriform pit or excavation.

My second example of *marginata* is from Western Australia. It is considerably smaller than the typical example (length 8 lines); the chin is strongly bearded; the two impressions on the prothorax are placed further from the base; and the 3rd and 4th ventral segments are distinctly sinuate behind: these differences are possibly sexual, although I can see no difference in the form of the anterior tibiæ; at any rate they are not of sufficient value to warrant me in holding it as a distinct species.

Hypaulax tarda, mihi, *l. c.* p. 262.

This species also appears to be very rare, as I have been able to add but a second example. It is at once to be distinguished from the two preceding by its strongly transverse prothorax, with the hind angles more acutely produced and more outwardly directed, and by its somewhat "squat" figure; the mandibles are notched at the apex; the labium is broadly emarginate in front, the space between the palpi narrow, its face but little convex; the gular furrow is broad but less deep than in those preceding; the cheek-furrow is slightly arched, and does not terminate near the gular furrow in an expanded subpyriform excavation; the 4th ventral segment is convex and strongly and somewhat sinuously emarginate behind; and the sides of the prothorax are more finely margined; the intervals between the rows of punctures on the elytra are flat, even at the sides and

apex; the 9th row of punctures is joined behind (apically) to the 1st, the 8th to the 7th, the 6th to the 3rd, and the 5th to the 4th; these differences, added to those given in the original description, will readily enable any one to separate the species.

My second example is from *Wide Bay*: it differs from the typical one only in the head having a rounded depression on the crown, the impressions &c. on the prothorax less strongly marked (almost obsolete), the elytra more convex and consequently more abruptly declivous behind, the striæ a little fainter, the punctures larger, and the intervals a little less flat.

Hypaulax opacula, n. sp.

Oblong, or oblong-ovate, sometimes elongate-ovate: black, subopaque. Labium broadly emarginate and densely ciliate in front, the space between the palpi wide and scarcely convex on the disk; mandibles strongly notched at apex; mentum strongly transverse, strongly angulate at the sides, front margin notched in the middle, a large round fovea on the disk, and, in six out of the seven examples before me, densely hirsute (in the seventh it is entirely naked); gular furrow strong, placed distinctly further from the base of the submentum than in the species preceding; cheek-furrow as in *H. tarda*, but not extending nearly so close to the gular furrow; the submentum, and that portion of the gula before the furrow, more convex or bulging than in any of the preceding: head formed as in *H. tarda*, very minutely and distantly punctulate, the punctures more numerous on the epistoma; epistomal suture well marked, angulate at the sides; vertex convex: prothorax opaque, more or less transverse, regularly but not strongly convex, feebly emarginate in front; base bisinuate, and a little wider than the apex, sides more or less strongly and regularly rounded, and more or less distinctly sinuous in front of the hind angles, which are ordinarily subacute and directed backwards (in some examples they are a little outwardly directed); median dorsal line very faintly marked; the entire surface minutely punctulate (in some examples almost imperceptibly so), and there are ordinarily several more or less distinct oblong impressions at each side of the disk and nearest to the base; the lateral edges though thickened are not, except sometimes at the hind angles, at all channelled or lined within this thickened edge or margin, and have not the appearance of a recurved plait or fold having a fine groove or channel within, as is the case with all the other species of the genus; scutellum convex, almost equilaterally triangular, pointed behind: elytra subovate, a little less opaque than the prothorax, distinctly wider at base than base of pro-

thorax, faintly striated, obsoletely so, or not at all, on the disk; the punctures large, irregular, ordinarily oblong; frequently two or three run together; apically the arrangement of the rows of punctures is the same as in *H. tarda*; intervals more or less (but never at all strongly) convex, impunctate: prosternal process wide, transversely rugose, broadly rounded behind, strongly tricarinate, the central carina enclosed by the two outer; third and fourth ventral segments sinuously emarginate behind: legs and underside shining black; tarsi, palpi, and antennæ piceous; anterior tibiæ elongate, more curved near the apex in the ♂.

Length 6 to 7½ lines.

Hab. Rockhampton. Seven examples.

A very distinct species, and at once to be distinguished from all the others by the form &c. of the prothorax, especially by the character of its lateral edges, as indicated above.

Hypaulax ampliata, n. sp.

Oblong, broad, black, slightly shining. Labium broadly and sinuously rounded and ciliate in front, the space between the palpi rather wide, its face very convex and longitudinally channelled down the centre; mentum naked, plane, transversely cordiform, with the usual small wing-like expansion on each side the apex at back; mandibles broadly and squarely truncated at apex; gular furrow deep but not wide, very distant from base of submentum; cheek-furrow very short (almost obsolete), scarcely extending beyond the upper corner of the eye beneath: head and prothorax more or less distinctly but very finely punctulate, most strongly so on the epistoma; epistomal suture distinct, arched, a little sinuous in the middle: prothorax ample, transverse, subopaque, but little convex, distinctly widest in front, apex very feebly emarginate, front angle almost obsolete; sides strongly rounded anteriorly, then subparallel to behind the middle, thence rapidly contracted to the hind angles, which are small, scarcely prominent, and slightly outwardly directed; base very broadly lobed in the middle, and extending further backwards than the hind angles; lateral edges strongly thickened, except in front of the hind angles, abruptly interrupted or notched immediately behind the middle; scutellum convex, strongly transversely triangular: elytra a little shining, broadly oval, moderately convex, distinctly wider at base than base of prothorax; base strongly emarginate; basal ridge very thick and prominent, and clearly continuous with the sutural interval, the ordinary short scutellar row of punctures either altogether absent or represented by a single faint oblong impression; more or less faintly striated

(obsoletely on the disk), the punctures moderate but deep, rounded or oblong; intervals nearly flat, more or less visibly but always minutely punctulate; apically the 1st stria is joined to the 9th (the 8th being joined to 9th at some distance from the apex), the 7th to the 2nd, the 6th to the 3rd, and the 5th to the 4th, or 3 and 4, 5 and 6, and 7 and 8 are joined together behind in pairs: prosternal process very wide, strongly tricarinate, the middle carina much the widest and not enclosed by the two outer; end broadly truncated or trilobed behind, in the latter case the middle lobe is the most prominent; flanks of prothorax smooth: legs rather slender, and, together with the underside, antennæ, &c., shining black.

Length 12½ to 13½ lines; width of prothorax across the middle 4½ to 5 lines; width of elytra behind the middle 5½ to 6 lines.

Hab. Champion and Nicol Bay, West Australia. Two examples.

Var. *Parryi.*

Smaller (10½ to 11½ lines) than the type, more convex, especially the prothorax, the punctuation on the intervals of the elytra obsolete or altogether absent, and the striæ at the apex confusedly united to each other.

Two examples obtained from the collection of Major Parry, labelled "Voyage of the 'Beagle.'"

Hypaulax orcus, Pascoe (*Nyctobates*), Journ. Ent. ii. p. 453.

This very variable species is nearly related to the preceding, but may be distinguished by its more oblong parallel form; the prothorax is less strongly transverse, the apex decidedly arcuate emarginate, the front angles consequently appear more prominent, and are subacute or narrowly rounded; the sides anteriorly are much less strongly rounded, the hind angles longer, more acute, and obliquely outwardly directed, the apex is wider, equal to, or narrower than the base; the head and prothorax are almost smooth; the base of the elytra less distinctly wider than the base of the prothorax; the striæ more distinct, the intervals, especially at the sides and apex, convex; the legs are stouter; the gular furrow situated a little nearer to the base of the submentum; the flanks of the prothorax strongly wrinkled on the middle; the middle carina of the prosternal process much narrower, the two sulci are consequently much wider and are continued in front (at right angles) halfway across the sternum, in front of the coxæ, the prosternum thus appearing to have a strong transverse impression before the coxæ; this

last character, and the rugosities on the flanks of the prothorax, will immediately serve to differentiate the two species.

Length 11 to 12 lines; width of prothorax across the middle $3\frac{4}{5}$ to $4\frac{1}{5}$ lines; width of elytra behind the middle $4\frac{1}{5}$ to 5 lines.

Hab. Swan River and Champion Bay, West Australia. Six examples.

Var. *acutangulata.*

Two examples from New South Wales slightly differ in being a little smaller (10 lines), in having a distinct longitudinal impression on the cheek, starting from the lower corner of the eye beneath; the striæ on the elytra stronger than ordinary, the intervals more convex and, at the sides and apex, subnodulose. In one of the examples the prothorax is strongly transverse, and the lateral thickened margin is abruptly expanded (just below the ordinary notch behind the middle) into a broad rounded tooth, and the hind angles are very acute.

Note. The mandibles in *H. orcus* and *H. ampliata* have the apex broadly and squarely truncated; in all the other species the apex is more or less strongly notched or bifid.

Hypaulax tenuistriata, n. sp.

Oblong, robust, black, shining. Labium deeply and widely emarginate in front, with a tuft of hairs at apex of central portion (between the palpi); mandibles strongly notched at apex; gular furrow strong, very near to the base of submentum, a short longitudinal groove extending from base of submentum to the gular furrow; cheek-furrow broadly and deeply impressed, extending obliquely from the upper edge of the eye beneath to close to the gular furrow: mentum more or less transversely subcordiform, more or less densely clothed with hairs (sometimes very sparsely so); the hairs shorter, finer, and less intermingled than in any of the preceding that have hirsute mentums: head and prothorax minutely (the former very sparsely) punctulate; crown sometimes impressed by an irregular transverse line and by two small foveæ, in others it is a little more convex and smooth; epistomal suture well marked, angulate at the sides: prothorax transverse, convex, feebly emarginate at apex, and always narrower than at base; anterior angles not prominent; sides more or less strongly rounded to behind the middle, thence contracted in a curve to the hind angles, which are moderately prominent and acute and directed backwards; base subsinuously truncated; sides finely margined or thickened, more or less crenulated, and sometimes notched or interrupted at the middle, a little reflexed, distinctly (though not broadly) channelled within the thickened

border; ordinarily there are two more or less distinct and rounded foveæ at each side of the median dorsal line, which is obsolete: scutellum transverse, broadly rounded behind: elytra oblong or oblong-ovate; base truncated, the thickened basal margin rather narrow, not clearly continuous with the sutural interval; finely but distinctly striated, the punctures in the striæ small (especially on the disk), close-set, narrow, oblong; ordinarily the striæ 3 and 4, 5 and 6, and 7 and 8 are united behind in pairs; sometimes, however, it is 3 and 4, 5 and 8, and 6 and 7 that are united; the short scutellar row consists of from five to eight small close-set punctures; intervals flat on the disk, sometimes convex on the sides, indistinctly punctulate: prosternal process tricarinate; the middle carina enclosed by the two outer, which are ordinarily transversely corrugated: legs robust and, together with the underside, shining black; tarsi, antennæ, and palpi dark castaneous.

Length 8–10½ lines.

Hab. Queensland (Rockhampton) and New South Wales. Nine examples.

At once to be distinguished from all the preceding by the finely punctured striæ of its elytra and its more glossy black surface. Like all the other species of which a series of examples has been obtained, the form of the prothorax (especially) and of the elytra is subject to considerable variation.

Hypaulax oblonga and *H. ovalis*, mihi, *l. c.* p. 263.

A careful examination of a series of nearly forty examples has convinced me that the specimens (one of *oblonga* and two of *ovalis*) on which I founded these two species are really the extreme forms of but one species. As the form *ovalis* has been figured (*l. c.* plate xii. fig. 1) it will be most convenient to take that name for the species: therefore *oblonga* = *ovalis*.

This species is intensely variable in the form &c. of the prothorax *, especially in the amount of rounding of the sides anteriorly. The elytra also are variable as to form; they may be subparallel (as in the form *oblonga*) or decidedly oval; and there exists every variety of form between.

This species may be at once distinguished from all the others by the deeply crenate-striate elytra and convex intervals, and by the labium, which has a deep rounded excision at each side in front, the middle portion between the palpi being prominent and rounded in front, and ordinarily without a tuft of hairs.

* It was in error that I described the prothorax of *oblonga* as longer than wide.

From *H. tenuistriata*, with which it is most closely allied, it may be separated by the above characters, and also by its more slender form, the gular furrow placed less close to the submentum, the absence of the short longitudinal groove from base of submentum, the cheek-furrow shorter and more or less recurved round the lower (narrow) edge of the eye beneath.

Out of the whole of the examples of both sexes I possess of this species but one has the mentum clothed with hairs; this, coupled with what we have seen before in the other species, makes it quite evident that the bearded chin possesses neither specific nor even sexual value.

Hypaulax gayndahensis and *H. opacicollis*, MacLeay, Trans. Ent. Soc. N. S. Wales, ii. pp. 284 & 285.

As the descriptions of these two species extend to but little over two lines for each, I find it impossible to decide whether they belong to any of my species or not. In a difficult genus like the present, the species of which are subject to great individual variation, it is impossible intelligibly to characterize the species in such short descriptions.

ASTATHMETUS, n. g.

Mentum slightly pedunculate, winged; the central portion large, prominent, not wider than long, hexagonal. *Maxillæ* with the inner lobe unarmed; last joint of the palpi elongate-triangulate, the outer side longest. *Labium* strongly transverse, partly concealed by the mentum, broadly emarginate and ciliate in front; palpi distant, the last joint oval, with the apex broadly truncated. *Gula* strongly transversely sulcate. *Submentum* small, transversely triangular, a deep longitudinal sulcus extending from its base to the gular furrow. *Cheeks* beneath strongly sulcate, the furrow extending obliquely from the base of the antenna, skirting the upper edge of the eye, to close to the gular furrow. *Mandibles* broadly truncated, and slightly notched near the lower edge at apex. *Head* subprominent, subquadrate; front a little depressed; front and epistoma together trapeziform: *antennary orbits* well rounded. *Epistoma* squarely truncated in front; the suture well marked at each side. *Labrum* transverse, front angles well rounded, fore margin ciliate and slightly emarginate. *Antennæ* feebly perfoliate; joints 3–6 obconic and a little nodose at apex, 3 longer than 4, 4–6 gradually a little shorter, 7–10 gradually larger and wider, depressed, 11 large, subovoid. *Eyes* moderate, rather prominent, narrow, transverse, obliquely contracted

below. *Prothorax* subquadrate, wider than long, but little convex; apex slightly sinuously emarginate; front angles not prominent; sides very moderately rounded, a little incurved before the hind angles, which are small, subacute, and outwardly directed; lateral edges a little sinuous, unequally thickened, and channelled within; base feebly bisinuate, rather thickly margined. *Scutellum* rather large, curvilineally triangular. *Elytra* elongate-oval, widest behind the middle, and somewhat attenuate at apex, moderately convex, gradually declivous behind; base emarginate, scarcely wider than base of prothorax, without trace of a thickened margin; shoulders a little oblique: *epipleural fold* entire (though narrow and becoming vertical) behind. *Metasternum* short: *intercoxal process* wide, rounded at apex: *prosternal process* broad, strongly tricarinate, the middle carina enclosed by the two outer; end broadly truncated. *Mesosternum* subhorizontal, broadly concave in front, deeply and obliquely impressed at each side above. *Legs* rather slender: *tibiæ* a little thickened outwardly, obsoletely spurred: *tarsi* tomentose beneath; first joint of the posterior of nearly equal length to the last.

This is the third known genus of the *Cœlometopides*, having at the same time both cheek- and throat-furrows. From the other two (*Hypaulax* and *Chileone*) this may at once be distinguished by the elongate-ovate and less convex form, the square prothorax, and the total absence of a thickened margin to the base of the elytra.

Astathmetus alienus, n. sp.

Elongate-ovate, attenuate behind. Black, subopaque. Throat-furrow a little arched: head (except the epistoma) and prothorax indistinctly punctulate: elytra less opaque than the prothorax; on each elytron nine punctured striæ, the striæ very fine; the punctures narrow, oblong, well impressed, those on the sutural row smallest, and becoming gradually larger and stronger towards the sides; a short scutellar row of four or five punctures; intervals smooth, impunctate, flat on the disk, a little undulate at the sides: legs and underside shining black, minutely punctulate; flanks of prothorax smooth, impunctate; antennæ and palpi pitchy, outer joints of the former dusky.

Length 11 lines; width of elytra behind the middle 4¼ lines.

Hab. Colombia. One example.

[To be continued.]

VI.—*The Geographical Relations of the New-Zealand Fauna.* By Captain F. W. Hutton, C.M.Z.S.*

I know of no part of the world that presents such a promising field to the student of nature as New Zealand. Although small in size, it contains a fauna and flora so peculiar that several naturalists consider it a separate biological province apart from the rest of the world. Isolated from any large continental area longer probably than any other portion of the earth, it contains the remnant of the population of a continent that existed before the Mammalia had overspread the world; and to that has at various times been added, principally from Australia, a colonist population which culminated not many hundreds of years ago in the advent of man. New Zealand, therefore, presents us with what I may call the elements of a continental fauna, or a continental fauna in its simplest state, and consequently in that state which is most advantageous for studying the mutual relations of the animals composing it.

Both Mr. Darwin and Mr. Wallace call New Zealand an "oceanic island" from a zoological point of view, owing to the absence of terrestrial mammals and the meagreness of its fauna and flora; that is to say, they consider it an island that has never formed part of a continental area since its last emergence from the sea. But I think that the Struthious birds have certainly as much weight in determining this point as terrestrial mammals, for they have no superior means of dispersion; and New Zealand also possesses a frog, which is one of the great characteristics of a continental fauna. From a geological point of view, I do not see how any land, except volcanic and coral islands, could have originated except as part of a large continental upheaval. I think, therefore, that the New-Zealand fauna may be correctly called the remnants of a continental fauna, and that a close study of it will throw great light on many of the most important, but at the same time most obscure, problems in zoology. It will, however, be long before this can be accomplished. The describing and naming of the different animals, which is the foundation upon which all other researches must rest, is as yet far from being completed; the determination of what species are the original inhabitants, or the descendants of the original inhabitants, of the former continent has hardly been attempted; but all this must be settled before any sound deductions can be drawn as to the reasons of extinction, variation, or permanency of type of the animals.

* Communicated by the Author, from the 'Transactions of the New Zealand Institute,' vol. v. 1872.

It is to this latter point that I wish to draw attention—not that I am in possession of information sufficient to prove any one perhaps of the points that I shall raise, but because I think that sufficient is known to establish with great probability the main features in the zoological history of these islands; and this sketch which I now presume to offer will, I hope, induce others to examine the subject more in detail, and will give a systematic direction to their observations. I propose to take first the zoological evidence—to point out the principal facts that have to be accounted for and the deductions that they lead to; I will then rapidly glance at the geological and palæontological evidence; and, finally, I will draw up from the whole the hypothesis that appears best able to account for all the phenomena.

MAMMALIA.

Of our two bats, one (*Scotophilus tuberculatus*), although not found elsewhere, is closely allied to those of Australia, while the other (*Mystacina velutina*) forms the only species of a genus peculiar to New Zealand, but related to bats living in South America.

Two species of seal frequent our shores—the sea-leopard (*Stenorhynchus leptonyx*), which is also found on ice-floes in the antarctic seas, and occasionally extends to Australia, and the fur-seal (*Arctocephalus cinereus*), which is supposed to occur also on the southern coasts of Australia, and is closely related to, if not identical with, a species found at the Falkland Islands, Cape Horn, South Shetland, and South Georgia. In the Otago Museum there is also a skull that appears to belong to the sea-elephant (*Morunga proboscidea*). Mr. Purdie informed me that it was picked up a long way inland.

Of the Cetacea, some twelve or thirteen species are known, belonging to the six different families into which the marine members of this order have been divided; and it is remarkable that two thirds of them are endemic—that is, not found anywhere else. Our two or three species of whalebone-whale have, up to the present, been found nowhere else. The sperm-whale of our northern coasts is probably the same species as that found in Australia and the South Pacific (*Catodon australis*); it is certainly distinct from the northern sperm-whale (*C. macrocephalus*), as the lower jaw is much narrower*.

Our ziphioid whales, of which we have three or four species, are all endemic; and two of them (*Berardius Arnuxii* and *Me-*

* A lower jaw of the New-Zealand sperm-whale in the Auckland Museum is 17 ft. 7 in. in length and only 2 ft. 2 in. in width at the condyles; there are twenty-three teeth on each side, four of which are rudimentary only; the length of the largest tooth is 7·4 in.

soplodon Hectori) belong to genera not found elsewhere. None, however, of our Delphiniidæ are confined to New Zealand. *Delphinus novæ-zealandiæ* inhabits the antarctic seas and perhaps Tasmania; *Lagenorhynchus clanculus* is found throughout the Pacific Ocean, but not in Australia; and *Orca capensis*, a lower jaw of which is in the Auckland Museum, ranges from the Cape of Good Hope through the Southern Ocean to Chili, and is also found in the North Pacific and Tasmania. The blackfish (*Globiocephalus macrorhynchus*) is found in the South Pacific and Japan, but not in Australia. Our Cetacea, therefore, contrary to what might have been expected, show a nearer relation to the Pacific and Antarctic oceans than they do to Australia; and it is remarkable that no species of porpoise has as yet been described as found in New Zealand, although two inhabit Tasmania.

The absence of terrestrial Mammalia is one of the chief points of interest in New-Zealand zoology, as it proves that there has been no land communication between this country and Australia since the latter was inhabited by Marsupials; for I consider that the so-called Maori rat and native dog were both introduced by human agency*.

Sir George Grey informs me that he sent to the British Museum some grey "Maori rats" which had been caught in the interior of the South Island in 1847 by Mr. Torlesse, and that Dr. Gray had said that they were identical with a rat found in Polynesia, by which he must have meant the black rat (*Mus rattus*); for none of the islands in the Pacific possesses an indigenous rat. Dr. Buller also collected a considerable amount of evidence to show that the "kiore-maori" was identical with a rat (now in the Colonial Museum) which he described (Trans. N.-Z. Inst. iii. p. 1) under the name of *Mus novæ-zealandiæ*, but which is certainly *Mus rattus*. Mr. Colenso says (Proc. R. Soc. of Van Diemen's Land, 1851, p. 301), in a letter to R. Gunn, Esq., dated 4th September, 1850, that after considerable trouble he had procured two specimens of the native rat, which he describes as "smaller than our English black rat (*M. rattus*), and not unlike it." Against this we have the statement of Dr. Dieffenbach, who says ('New Zealand,' ii. p. 185) that it was the English and not the Norway rat that killed off the "kiore-maori." This, I think, must be a mistake, as all the Maoris attri-

* Captain Cook remarks, in his first voyage, that rats were "so scarce that many of us never saw them" (Hawkesworth's 'Coll. of Voy.' iii. p. 84). He makes no mention of their ever being used for food; and I am not aware of any remains of rats having been as yet found in Maori cooking-places.

bute the destruction of the edible rat to the brown rat, and it could only have been from Maoris that Dr. Dieffenbach got his information. Mr. Murray also states (Distr. of Mammals, p. 277) that the Norway rat (*M. decumanus*) was not introduced into New Zealand in 1843; but he gives no evidence of the truth of this statement; and it is unquestionably erroneous *. The whole of the reliable evidence that we have, therefore, goes to prove that the Maori rat was no other than *M. rattus*.

The so-called "native dog" has been determined by Dr. Gray to be *Canis familiaris* (Proc. Zool. Soc. 1868, p. 508), and not the Australian species or variety called *Canis dingo*, which is the strongest possible evidence of its being merely an escaped domestic breed; indeed I am not aware that any naturalist believes in an indigenous native dog, except Dr. Haast, who has argued (Trans. N. Z. Inst. iv. p. 88) that a wild dog existed in New Zealand before the domesticated one, because in certain old Maori cooking-places he has found remains of the dog but no gnawed bones; while in others, which he considers of later date, he finds gnawed bones †. But I am not aware that he has any proof of the existence of a dog in New Zealand before the arrival of man; the difference of date of these cooking-places for which Dr. Haast contends is denied by many observers, and his argument derived from the presence or absence of ground stone implements has, I think, been successfully controverted. I can therefore attach no weight to the absence of gnawed bones. On the other hand, there is the fact that no indigenous dog or rat has ever been found on an island that was not inhabited by other Mammalia; and when we remember that Marsupials came into existence long before rats and dogs, it is difficult to see how the latter could possibly get to any country without the former coming also. It is evident that neither Banks, nor Solander, nor the Forsters considered the dog and rat that they found in

* Since reading this paper Mr. Nichol has informed me that the brown rat was common in Nelson when he first arrived in the early part of 1842, and that he never saw any other kind there except a single specimen of a very large and slightly striped variety.

† The skulls of dogs found in old Maori cooking-places prove undoubtedly that *Canis familiaris* existed in New Zealand long before Europeans came here. Captain Cook says (21st October, 1769) that the dogs were "small and ugly;" and Mr. Anderson ('Cook's Third Voyage,' i. p. 153) calls it a "sort of fox-dog." Captain Cook also says in his first voyage that the dog was used for no other purpose than to eat. The fact that the inhabitants of the Friendly Islands have the same name (*kuri*) for the dog as the New-Zealanders is strong evidence that the latter brought it with them; for if not, they would have lost the name, as they have done that of the fowl.

New Zealand a new species, or they would certainly have mentioned it; neither did Lesson in 1827, nor Quoy and Gaimard in 1831. Dr. Dieffenbach in 1842 was the first to state that a frugivorous rat, distinct from *M. rattus*, existed in New Zealand, he probably not being aware that *M. rattus* is entirely frugivorous. I am therefore of opinion that both the rat and the dog were brought by human agency; and it is worth remarking that the Maori traditions relate that they brought both with them (Travers, Trans. N. Z. Inst. iv. p. 58). The specimen of *Mus Gouldi* in the Auckland Museum (see Trans. N. Z. Inst. iii. p. 3) was caught, I believe, at the Thames in January 1853; and as a mission-station had been established there some years previously, this specimen was no doubt brought over from Australia in their vessel.

The animal seen at Dusky Bay by some of Captain Cook's sailors (Second Voyage, i. p. 98) was probably a dog, as none on board had at that time seen a dog in New Zealand.

The evidence of a kind of otter inhabiting the South Island rests upon some footprints seen by Dr. Haast, and mentioned by him in his first presidential address to the Canterbury Philosophical Society (Nat. Hist. Rev. 1864, p. 30). In the same address he also mentions having seen tracks in great numbers of a small jumping mammal in the river-bed of the Hopkins; but as no further evidence of the existence of these creatures has been adduced, although eight or nine years have since elapsed, it is impossible for me to take any further notice of them in this paper.

Birds.

The first point that claims our attention here is the great development of the Struthious birds. This division can be subdivided into two families—one (*Apterygidæ*) containing only the kiwis, and the other (*Struthionidæ*) including all other living forms as well as the extinct moas. The kiwis in the structure of the egg-shell have an affinity with the Carinate division of birds. Their short legs, and the presence of a hind toe elevated above the level of the others, show an approach to the Gallinaceous order; while their long bill, with its slightly swollen tip, resembles in some measure that of the Scolopacidæ, which have also the same habit as the kiwi of feeling about on the ground with their bill. *Gallinago pusilla*, moreover, lives in holes, and only comes out at night (Travers, see Art. xxii.).

Thus the Apterygidæ have a more generalized structure than the other Struthious birds; they therefore belong to an older type, and cannot with any degree of correctness be said

to represent the extinct race of moas. The relations between the second family, or the Struthiones proper, are very complicated; but *Dinornis*, which alone concerns us here, appears to be intermediate between the rheas of South America and the emus and cassowaries of Australia and the adjacent islands. *It approaches the rhea in the structure of its egg-shell, and in having only three pairs of sternal ribs; while the emu, the cassowary, and also the kiwi have four, and the ostrich five* pairs. In the structure of its feathers and in the shape of its pelvis and skull the moa approaches the emu. The Struthious birds exhibit a type of structure intermediate in many respects between the Carinate birds and the extinct Dinosaurians; and this leads naturalists to suppose that they are but the remnant of a race that once spread over the whole earth. About twelve species are known outside New Zealand; while here, besides our four species of *Apteryx*, Professor Owen has determined fourteen species of *Dinornis*, three of *Aptornis*, and one of *Cnemiornis*, thus making a total of twenty-two species of Struthious birds, belonging to four different genera, living in New Zealand only a few hundred years ago—that is to say, nearly twice as many as are found in all other parts of the world put together.

Probably, however, some of Professor Owen's species of *Dinornis* are but the young of others; and it seems to me very doubtful whether *Aptornis* and *Cnemiornis* should be regarded as struthious birds at all. It is evident that these two genera are closely related; and if the wing-bones placed upon *Cnemiornis calcitrans* really belong to the legs of the same bird, we must suppose that the sternum had a keel sufficiently developed to support muscles of a size proportionate to the wings; for although we can understand how the kakapo (*Stringops*), belonging to an order of deeply keeled birds, may have lost, by disuse of the pectoral muscles, the keel on its sternum, we cannot possibly explain how a struthious bird could have had large wing-bones developed unless it had also sufficiently powerful muscles to use them. I also observe that *Aptornis defossor* now wears a skull similar to that of the late *Dinornis casuarinus*, which skull Mr. W. K. Parker says undoubtedly belonged originally to a *Notornis*. But, omitting these two genera and making a due allowance for doubtful species of *Dinornis*, the great number of species living on so small an island is very remarkable when contrasted with other parts of the world. The continent of Africa, including Arabia, contains but one (or, according to some naturalists, two) species of ostrich. South America, from Patagonia to Peru, has but three species of rhea, each inhabiting a separate district.

Australia possesses two species of emu, one on the eastern and the other on the western side, and one species of cassowary on the northern, while five other species of cassowary inhabit other detached islands, from New Britain and New Guinea to the Molucca Islands. I believe that outside of New Zealand no two species of struthious birds are found living in the same district, while here we have now four species of kiwi, and not long ago had at least half a dozen species of moa as well. How can this be accounted for? The solution is readily found by examining the distribution of the cassowaries. Here we have six species inhabiting six isolated localities. If now this region of the earth were to be elevated, these six species might mingle; and if it were subsequently to sink again, all six species would undoubtedly be driven to the higher lands, and we should have in this supposed island a representation of New Zealand inhabited by six species of Struthious birds.

In order, therefore, to account for the numerous species of *Dinornis*, we must suppose an ancient continent inhabited by one or two species to sink and the birds to take refuge on the different mountain-ranges left as islands above the water. We must suppose that they remained thus isolated from one another for a sufficiently long period to allow of specific changes being brought about, that then by an elevation of the land they once more mingled together, and that, on subsidence again taking place, New Zealand, as the central mountain-chain, formed a harbour of refuge for them all.

Whether this isolation of species points to some cause as yet unrecognized, by which in the struggle for life no two species of struthious bird can live in close proximity, I will not venture to give an opinion; but it is a fair subject for inquiry, and one on which the careful study of the relative ages of moa-bones might throw considerable light, and enable us perhaps to understand the great mortality that must have taken place amongst the moas when confined to these small islands long before man set his foot here.

The distribution, therefore, of the Struthious birds in the southern hemisphere points to a large antarctic continent stretching from Australia through New Zealand to South America, and perhaps on to South Africa. This continent must have sunk; and Australia, New Zealand, South America, and South Africa must have remained isolated from one another long enough to allow of the great differences observable between the birds of each country being brought about. Subsequently New Zealand must have formed part of a smaller continent, not connected either with Australia or South America, over which the moa roamed. This must have been fol-

lowed by a long insular period ending in another continent still disconnected from Australia and South America, which continent again sank and New Zealand assumed somewhat of its present form.

Passing now to the Carinate division of birds, the first thing that strikes us is the fragmentary nature of this part of our avifauna (if we exclude the Grallæ and web-footed birds), thus strongly contrasting with the Struthious division.

Of the first six orders we possess (excluding the Chatham and Auckland Islands) forty-five species, thirty of which are endemic. These have been referred to thirty-one genera, ten of which are found nowhere else; and these thirty-one genera belong to twenty families, one of which (*Stringopidæ*) is peculiar to New Zealand. Two families only, the honey-eaters (*Meliphagidæ*) and the starlings (*Sturnidæ*), contain more than two genera. The first shows affinity to Australia; but it must be remarked that out of the four species of this family, belonging to four different genera, one genus only (*Zosterops*) is found in Australia, and the little bird (the "white-eye") that belongs to this genus is known to be quite a recent arrival in this country. The Sturnidæ, on the other hand, show an affinity with Polynesia; for one species only (*Calornis metallicus*) of this family is found in the north of Australia and in New Guinea. It should, however, be noticed that three other species are found in the latter island. In this family also our three species belong to three different genera, two of which (*Creadion* and *Heteralocha*) are found nowhere else, while the other (*Aplonis*) is very characteristic of Polynesia; and *Aplonis caledonicus*, which is said to have been found in New Zealand, occurs also in Norfolk Island and New Caledonia.

It is remarkable that our two owls should both be peculiar to New Zealand, and that one of them (*Sceloglaux albifacies*) should belong to a genus not found elsewhere; for the owls are usually widely spread birds, more so, indeed, than the hawks. It is also worthy of notice that *Strix delicatula*, which extends its range over most of the Pacific islands and Australia, should be absent from New Zealand.

Our parrots present several points of interest. The kakapo (*Stringops habroptilus*) is found nowhere else; the genus *Nestor* extends only to Norfolk Island, while our perroquets, although belonging to a genus (*Platycercus*) equally plentiful both in Australia and Polynesia, show a greater affinity to the latter, one species (*P. novæ-zealandiæ*) ranging not only to Norfolk Island, but also to New Caledonia. It is remarkable that we have no representatives of the cockatoos and grass-perroquets so common in Australia and Tasmania; for our own

climate is quite suitable for them. The absence of Polynesian forms is not so remarkable, as they belong chiefly to more tropical genera, and the members of the genus *Coriphilus* are said to live only on bananas.

That we should have two cuckoos which migrate regularly to other countries each more than a thousand miles distant, is a fact that deserves special attention; for I know of no parallel case in any other part of the world, the distance across the Mediterranean being less than half that travelled over by our summer visitants. The phenomenon of a bird at a certain season of the year flying out to sea to an island more than a thousand miles distant is remarkable enough, but is rendered still more so in the case of the little shining cuckoo (*Chrysococcyx lucidus*, which is supposed to come from Australia) by there being no apparent necessity for it; for this bird migrates east and west, and not from a warmer to a colder climate, and two other closely allied species which inhabit Australia never leave the country at all. Even in the case of the long-tailed cuckoo (*Eudynamis taitiensis*), which comes to us from the equable climate of the South-Sea Islands, we cannot suppose that its migrations are caused either by alteration of temperature or by want of food; and the question forces itself upon us, How could this habit have arisen? The only reasonable hypothesis is, I think, that at one time the different lands to and from which these birds fly were connected, or nearly so, that the distance between them gradually increased, and that the habit so common amongst birds of resorting each year to the same place to breed was not lost, but gradually merged into a regular migration. From this point of view, the arrival of the shining cuckoo indicates a connexion with Australia or perhaps New Guinea, while that of the long-tailed cuckoo indicates one with Polynesia; and it must be noticed that, while the latter bird is identical with specimens from Polynesia, the former shows such differences in the colouring of the tail-feathers from the birds inhabiting Australia, that it is considered by many naturalists to be a distinct species. Another remarkable fact that has been quite lately brought to light is that the shining cuckoo of the Chatham Islands is not the same variety as that visiting New Zealand, but is almost, if not quite, identical with an Australian species (*C. plagosus*). This curious fact proves how strong must be the force of habit; for these birds in their migration to and from the Chatham Islands must pass over, or at least in sight of, New Zealand; but instead of stopping after a journey of 1400 miles, they continue on for 450 miles more, until they reach the little island that they have selected as their home.

A more difficult fact to account for is the presence of different species of grass-bird (*Sphenœacus*) in both Australia and New Zealand; for this bird has such feeble powers of flight that it could not cross a river, and must almost of necessity have travelled by land. It must, however, be noticed that this genus extends through the Indian archipelago into India, and I have not been able yet to compare our grass-birds with those of Australia and the archipelago, so that I am not able to say what amount of difference there is between them. The genus *Keropia* has most affinity with South-American birds, while *Graucalus melanops*, which is closely related to our *G. concinnus*, is said to extend from Australia into New Guinea.

In the order Grallæ, or Waders, we come to birds more widely spread than any others, some indeed being almost cosmopolitan: but even amongst these the isolated character of our fauna is still marked; for out of twenty-eight species belonging to seventeen genera eight species and two genera are found nowhere else. The most noticeable feature in this order is the existence of a curious genus of rails (*Ocydromus*) quite unable to fly. Of this genus we possess four species, one in the North and three in the South Island, while a fifth species is found in Lord-Howe Island, and a sixth in New Caledonia. *Notornis*, although somewhat like the pukeko (*Porphyrio melanotus*) in the bill, has the feeble wings, thick legs, and short toes of *Tribonyx Mortierii* of Tasmania and Australia. Of our other rails, two (*Rallus pectoralis* and *Ocydromus tabuensis*) are spread over Australia and Polynesia, while another (*O. affinis*), although not found elsewhere, is closely related to a species from Australia (*O. palustris*). In the godwit (*Limosa uropygialis*) we have another migratory bird that probably comes from Polynesia; but as it is also found in Australia, we cannot feel any certainty about it. New Zealand also displays the peculiarity of being the only country in the world inhabited by two species of stilt-plover (*Himantopus*), one of which (*H. novæ-zelandiæ*) is found nowhere else. This is probably owing to the length of time that New Zealand has been isolated, and to its having had during the whole of the period a stilt-plover on it, which gradually changed until it attained that remarkable jet-black plumage which is so different from that of any other species; while the later colonist from Australia (*H. leucocephalus*) displays the colour usual to the genus. This view is rendered the more probable by the fact that the young of the black stilt-plover have the same pied plumage that is exhibited by the adults of those species from one of which I suppose it to have been derived.

In the crookbill (*Anarhynchus frontalis*) we have another

curious anomaly which as yet has received no explanation; and it must also be noticed that Cape Horn, the Cape of Good Hope, Australia, and New Zealand possess each a black oystercatcher (*Hæmatopus*) which are considered specifically distinct.

Among the herons the only very remarkable fact is the occurrence of the little bittern (*Ardea pusilla*), a bird found only in Australia and Natal. Our snipe (*Gallinago pusilla*) very much resembles in plumage *G. Stricklandi* from Tierra del Fuego, but it has a shorter bill.

Among the web-footed birds the first thing that claims our attention is the oceanic family of the petrels (*Procellariidæ*), for although by no means peculiar to New Zealand*, the great number of species in the southern oceans in comparison with the small number in the northern is very noticeable. The northern and tropical species have all closely allied forms in the southern hemisphere, while many of the southern petrels (such as *Ossifraga*, *Halodroma*, *Majaqueus*, *Pterodroma*, *Daption*, and *Prion*) have no representatives in the northern seas This leads to the inference that the northern species have been derived from stray southern birds, and that the southern hemisphere has been the centre from which most oceanic birds have spread, while land birds, on the contrary, have spread chiefly from northern areas; and this leads to the further inference that the southern hemisphere has been for many ages more oceanic in character than the northern. The next most remarkable point is the great development of the cormorants, New Zealand possessing nine species, four of which are found nowhere else. No other country in the world possesses so many; and the phenomenon can only, I think, be accounted for in the same way as the numerous species of moa—that is, by the former existence of several small islands which have since been elevated to form the present New Zealand. The wide dispersion, however, of two of our cormorants is rather against this view, one (*Graculus caruneulatus*) being found at the Crozet Islands and at Cape Horn, and the other (*G. carbo*) in Australia, China, and Europe. I must, however, remark that the identity of the first has not yet been perfectly established, and that the second, although very closely resembling specimens from Europe, shows at the same time some difference. It may also be useful to remark here that our gannet (*Dysporus serrator*), although a far better-flying bird than the cormorants, is not found at the Chatham Islands; and Dr. Finsch informs me that it is undoubtedly different from

* *Procellaria Parkinsoni* is peculiar to New Zealand.

the species (*D. capensis*) that occurs at the Cape of Good Hope. The occurrence of *G. brevirostris* and *G. melanoleucus* in New Zealand presents a parallel case to the two species of stilt-plover, with, however, this difference—that, judging from the colours of the young bird, it is probable that *G. melanoleucus* has been derived from *G. brevirostris* owing to its having been isolated in Australia, and that its descendants have migrated back again to New Zealand.

Of the gulls we possess a species (*Larus pomare*) which is found nowhere else—a peculiarity of which few countries can boast, but which can perhaps be accounted for by the fact that this gull only frequents freshwater lakes and seldom comes down to the sea. Our other gulls are widely spread; but it is a most remarkable fact, which at present appears to me to be quite inexplicable, that neither gulls nor cormorants occur in any of the Polynesian islands.

Of ducks we possess nine species, four, or perhaps five, of which are endemic—one, the blue duck (*Hymenolæmus malacorhynchus*), belonging to a curious genus found only in New Zealand, but related to a genus (*Malacorhynchus*) in Australia. The others are all found in Australia—one (*Pterocyanea gibberifrons*) ranging through New Caledonia and the Indian archipelago, and another, the common grey duck (*Anas superciliosa*), spreading over Polynesia as far north as the Sandwich Islands. The most remarkable circumstance connected with our ducks is the presence of a species of *Fuligula*, a genus found neither in Australia nor Africa, but belonging properly to the northern parts of America, Europe, and Asia, although one species is found in South America. The occurrence, however, of a northern species (*F. cristata*) in the Pelew Islands points out to us perhaps the route along which the ancestors of our species travelled.

The Chatham Islands possess thirty-two species of birds (omitting the gulls, penguins, and petrels), of which six are found nowhere else. All the others are found in New Zealand, except the shining cuckoo (*C. plagosus*), which, as already stated, migrates to and from Australia. No genus, however, is peculiar to these islands, except perhaps a rail (*Rallus? modestus*) which is evidently incapable of flight, and which will probably have to be placed in a genus by itself. This curious form must not, however, be regarded as a change produced by long isolation, but rather as an old form preserved from destruction by isolation. The most noticeable circumstance in the Chatham-Island fauna is the absence of Raptores, with the exception of an occasional visit from the harrier (*Circus Gouldi*), which does not, however, appear

to inhabit the islands, or at any rate is exceedingly rare there.

The Auckland Islands possess twelve birds, three or four of which are endemic, the remainder all belonging to New Zealand. The most remarkable facts are the occurrence of a species of merganser (*Mergus australis*), a genus found only in high northern latitudes, and of a duck (*Nesonetta aucklandica*) with very short wings, belonging to a genus found nowhere else.

On Norfolk Island we know of twenty-six birds. Of these, two (*Aplonis caledonicus* and *Platycercus novæ-zelandiæ*) are found in New Zealand and New Caledonia, five others are common to New Zealand and Australia, a species of *Nestor* (*N. productus*) used to inhabit Philip Island close by, and the remainder show an affinity to Australia.

Lord-Howe Island possesses only six land birds, two of which (*Charadrius bicinctus* and *Ocydromus sylvestris*) show a connexion with New Zealand, while the rest show an affinity to Australia.

A review of the facts disclosed by a study of the distribution of the Carinate birds shows that, although the affinity is greater with Australia than with any other place, there is yet a decided leaning towards Polynesia; and when we remember that a large portion of Australia lies in the same latitude as New Zealand, while the whole of Polynesia is far away to the north, I think the difference is not so great as might have been expected *. The distribution of the genus *Ocydromus* proves that land communication must once have existed between New Zealand, Lord-Howe Island, and New Caledonia; but the absence of cockatoos, grass-perroquets, pigeons, night-jars, and finches indicates that this connexion did not extend to Australia. With the exception of *Sphenœacus*, which has very feeble powers of flight, all our Australian birds could have crossed over a strait of considerable width. The phenomena of the perroquets, starlings, and long-tailed cuckoo of Polynesia being associated in New Zealand with the honey-eaters, grass-bird, and gold cuckoo of Australia, indicate that New Zealand was connected with a tract of land intermediate to both, but perhaps not connected with either; at the same time the absence of the more tropical Polynesian birds is no evidence that this tract of land did not extend into Polynesia; and in *Zosterops lateralis* and *Dendrocygna Eytoni*, both of which have appeared since Europeans came into the colony,

* The distribution of the Megapodidæ shows that Polynesia, Australia, the Indian archipelago as far as the Strait of Lombok, North-west Borneo. and the Philippine Islands were united before the spread of the mammals,

we have positive evidence that our islands can even now be colonized from Australia by many kinds of birds, although 1400 miles distant. It would also appear that this transfer of birds to New Zealand took place sufficiently long ago to allow of changes of generic value having taken place, while the Chatham and Auckland Islands have been isolated from New Zealand for a time sufficient only for changes of specific value.

Reptilia.

The Reptiles of New Zealand are not numerous. We possess about eight species of lizards, four of which belong to widely spread genera of the family Scincidæ; but the species are all endemic. Three others belong to the Geckotidæ, and form a genus (*Naultinus*) which is found nowhere else. Of these, one (*N. pacificus*) is said to be found in some of the Pacific islands; but the other two are peculiar to New Zealand. Our eighth species, the curious tuatara (*Sphenodon punctatum*), which is now found only on a few rocky islets in the Bay of Plenty and near Tory Channel in Cook's Strait, is placed by Dr. Günther in a separate order from all other lizards on account of the affinity that it shows to the crocodiles. This remarkable form has no copulatory organs, and has uncinate processes on its ribs like birds. It has also nearly twice as many abdominal as true ribs, which protect the abdomen when being dragged along the ground, for, as in the crocodile, the hind legs are too weak to support the hinder parts of the body; Dr. Günther also suggests that they may use these ribs for locomotion as snakes do. It is also remarkable that this animal, which lives in holes and only comes out during warm weather, should have the dorsal crest that is so characteristic of tree-lizards.

I omit all reference to *Norbea? isolata*, supposed to come from White Island in the Bay of Plenty, because its true locality is not sufficiently well established; if, however, another specimen should be obtained, it would be most important evidence in the present discussion.

But one species of lizard is found on the Chatham Islands, which is very variable, but which I consider to belong to the species *Mocoa zelandica*; it is, however, larger, and shows some slight differences in the shape of its cephalic shields.

A ringed sea-snake, probably *Platurus scutatus* of Australia and Polynesia, is sometimes washed alive on to our coasts as far south as the mouth of the river Waikato, but it is not yet ascertained whether it is an inhabitant of our seas. A peculiar variety of *Pelamis bicolor*, which as yet has not been found in any other locality, has also been taken on our shores.

Amphibians.

The amphibious animals are worse represented even than the reptiles, one species of frog (*Liopelma Hochstetteri*) being the only member of the class. This frog has now been found in three distinct localities, all, however, in the province of Auckland: these are, the Cape Colville ranges from Coromandel to Puriri, the Huia on the north side of the Manukau harbour, and the mountains behind Opotiki in the Bay of Plenty. It belongs to a genus not found elsewhere; but its nearest ally is *Telmatobius peruvianus* from Peru, and it should be remembered that the frogs of Australia are also allied to South-American forms. It is evident that the absence of other Batrachians cannot be accounted for by the unsuitability of climate or want of food; for the common green frog of Australia (*Litoria aurea*), which has been introduced, has spread with great rapidity around both Auckland and Christchurch.

The evidence of the reptiles, therefore, is that New Zealand has had land communication with some of the Pacific islands at a later date than with Australia; for in the first case there is no specific difference between forms found in both places, while in the latter the species are now quite distinct. Our frog proves a connexion with South America at a period so remote that changes have since taken place of generic value.

[To be continued.]

VII.—*On the Development of the Polypes and of their Polypary.* By M. H. de Lacaze-Duthiers.*

Last summer the Academy requested the Minister of Marine to permit my embarkation on board the 'Narval,' which was then occupied in completing the hydrography of the Algerian coasts. My object in undertaking this voyage was to study again the coral banks, the richness of which I had previously ascertained in 1860, 1861, and 1862.

During the voyage I have had the opportunity of collecting observations, the results of which, indicated in short notes, do not seem to have been accepted in France. I have been able to verify afresh the facts which I am now going to publish in detail, and I think that I ought first of all to communicate these results to the Academy.

I refer now to the development of polyparies.

* Translated by W. S. Dallas, F.L.S., from the 'Comptes Rendus,' November 24, 1873, pp. 1201–1207.

Science does not possess any extensive and connected work on the embryogeny of the polyparian polypes. Nearly all authors whose object has been the investigation of the mode of growth of the polypary have taken on the one hand the calices or polyparites which appeared to be youngest, and on the other those which seemed to be most completely developed, and then, by seeking the terms intermediate between these extremes, have endeavoured to deduce, from the gradual passage from the former to the latter, the laws either of the multiplication of parts or of the general mode of growth of the calices.

We do not find zoologists attempting to recognize the first traces of calcareous deposits in the bodies of the polypes while still in the state of embryos, and to follow these first inorganic nodules up to the complete formation of the calice or polyparite with all its elements. In a word, they have almost exclusively studied the isolated skeleton of the animal, or the polypary itself.

Laws, which we find prevailing in science, *have been deduced, not from the study of the framework during its formation in the embryo, but from the observation of the formed polyparites of different dimensions.* In other words, zoologists *have thought that they could affirm what must have been from what was at the moment of observation.*

In a polyparite (that is to say, in one of the calices of the polypary of an Actiniarian of whatever species) it is well known that there are radiating laminæ of various sizes. These laminæ of the first, second, third, to *n*th size alternate regularly in a certain order. The totality of those which are homologous or similar constitutes what is called a *cycle*. Seeing this, the same thought comes naturally to the mind of every observer; and it may be said that, in everybody's opinion, the equal laminæ forming a cycle are produced at the same period—that they commenced and continued growing simultaneously, which would explain their equality—and, finally, that the laminæ of different sizes are also of different ages, and that their extent is in direct proportion to the duration of their growth (that is to say, their age).

It may certainly be affirmed that this idea, which occurs naturally to the mind, has been the starting-point of the numerous laws formulated from the examination of specimens in collections—laws which have furnished the principal foundation for the classifications and for the nomenclature of the parts of polyparies, proposed especially by French authors. Certain German naturalists, particularly MM. Schneider and Rötteken on the one hand and C. Semper on the other, taking

up different points of view, have endeavoured to demonstrate the invalidity of these laws and the difficulty or impossibility of verifying or applying them which often exists.

One of my wishes when I went to Africa this summer was to find embryos and very young individuals of polyparian polypes, and to revise, with the view of verifying them, the various theories put forward as to the origin and mode of growth of polyparies. I was fortunate enough to obtain both embryos and very young polypes; and I have now the honour to present the results of my new observations to the Academy.

It is well known that the polype which clothes and produces a polypary presents round its mouth circlets of tentacles or arms of different sizes, that these tentacles have also been grouped in cycles, and that the same series of laws has been applied to their development as to that of the laminæ of the polypary. Now, by following the appearance of the tentacles upon the embryo, we cannot verify any of the laws which we find current; and this I proved in a memoir published last year*.

This causes great perturbation of mind when we desire to pass from the study of the soft parts of the animal to the knowledge of the development of its hard parts. In fact, each tentacle corresponds to a chamber in the body of the polype; and at the bottom of each of these chambers there rises one of the calcareous laminæ of the polypary. The question therefore arises at once, whether the chamber and the tentacle belonging to it, as also the calcareous septum which occupies it, follow the same or different laws in their formation.

I have been able during my voyage to ascertain the perfect exactitude of the following facts.

Two questions presented themselves. It was necessary, in the first place, to determine in what part and what elementary stratum of the organs the deposition of the calcareous particles of the calice commenced, and then what were the laws governing the appearance and multiplication of the parts of the polypary.

It was logically necessary, in order to trace the progress of the development of the calcareous parts, to know in the first place, just as in the case of the bones, where the first particles were deposited.

French authors suppose that it is in the dermis of the body of the polypes that the principal deposit takes place, and therefore they give the name of *Sclerodermi* to the group of corals here under consideration; but it must be remarked that it

* Archives de Zoologie expérimentale et générale, vol. i. 1872.

would be useful at starting to give a precise histological definition of the dermis, which has never been done. Now-a-days two layers are distinguished in the body-walls of polypes, an inner and an outer one, called the *ectoderm* or *ectothelium* and the *endoderm* or *endothelium*. French authors have spoken of these two layers; but they have subdivided them into numerous secondary layers separated by a plane of muscular fibres. It is therefore outside this muscular layer that the primitive deposition of the part which in their eyes is the most important takes place, namely that which forms the walls of the calice (*theca*).

Now the embryogeny and histology of the embryo, studied in young living *Astroides* of all ages, and not in polyparies at some given moment of their existence deprived of their soft parts, show without any possibility of doubt that the first calcareous nodules occur and appear in the inner layer or *endothelium*, the histological characters of which are absolutely different from those of the outer layer, which does not allow us to confound them.

Thus, as regards the histological origin of the polypary, it is impossible to continue to accept the old opinion, and consequently also the denomination Sclerodermi.

With regard to the law governing the mode of appearance of the septa of the polypary, the following appears to us to be no less certain. The primitive calcareous nodules first deposited, making their appearance in the thickness of the inner layer, clothe the bottom of the cavity of each chamber of the embryo while it is still without tentacles, and unite together to form usually a central band at the bottom of the chamber, this band being simple towards the middle of the body and bifurcate towards the circumference; so that at one moment we find at the bottom of each chamber a sort of calcareous Y, the branches of which turned outwards may be either very short or very long.

It is to be remarked that at this period there is no trace of any circumvallation or wall (*theca*), or exterior boundary of the calice.

By following these first deposits we find that they rise more and more beneath the inner layer, and that filling up the fork of the Y they produce projecting simple laminæ, one in each chamber of the embryo. These laminæ (the origins of the *septa*) become soldered to foreign bodies underlying the embryos, and constitute the first rudiments of the polypary.

Now, there are twelve chambers; there are consequently twelve primitive septa, and, I repeat, no wall. Nevertheless, by the examination only of the polyparies in collections,

zoologists have been led to assume that the wall was first developed, and that from it there originated first of all six septa at the same time, that these six primary laminæ, retaining the advance given to them by their age, were the largest septa in the adult, and so on for the septa of the second and third to the *n*th size. From this we have the admission of cycles the age of which was shown by the size of their elements. Nothing of this kind ever occurs in the embryo of *Astroides* or of the *Balanophylliæ*; and I have numerous examples of very young individuals all having twelve equal septa before possessing any wall, and in which the formation of cycle after cycle of six elements is not admissible.

It is no longer possible to admit that the septa originate from the wall, and to give the latter the preeminence over all other elements of the calice, since the septa are already well formed when there is no trace of a wall.

Thus as regards the first two cycles the laws according to which the absolute and relative moment of appearance of the septa and their origin as dependent on one of the elements of the calice were supposed to be governed have no foundation (*raison d'être*); and yet it was especially for these two cycles that these laws were accepted and most easily verifiable. With regard to histological origin it does not seem to us to be possible, at least in the embryo and the species investigated, to continue to attribute it to the dermic layer.

We recognize, therefore, at the origin of the polypary, a rule which does not fail with regard to the mode of multiplication of the tentacles in the Actiniaria without polyparies; and it is as follows:—The number of parts in accordance with a certain typical number is first formed; afterwards, a greater growth being manifested in certain of these formed parts, there results from it a symmetry which nothing could lead us to foresee if the embryo had not been followed from moment to moment.

It is thus that the tentacles of the *Actiniæ*, which we find sometimes arranged so regularly in successive cycles in accordance with the type 6 (6 of the first, 6 of the second, 12 of the third, 24 of the fourth, and 48 of the fifth magnitude) are far from having been developed 6 at a first period, 6 at a second, 12 at a third, and so on. The number 12 was first produced, passing successively through the inferior numbers 2, 4, 6, and 8 to 12. After its production the sizes alternately remained stationary in 6, and increased in 6 others. Then, but only then, was manifested the radiate symmetry with two cycles apparently of different ages, as indicated by the relation (6_1+6_2).

It is the same with the septa of the polypary. The number 12 is first of all produced, but with this difference, that the 12 elements all begin to show themselves at the same moment; and it is only later on that their unequal growth ranges them in two groups which appear to be of different age, whereas they are only of different sizes.

The facts here brought forward appear to us to be of absolute certainty. They have been repeatedly confirmed, sometimes upon polypes taken swimming in the sea in the form of the embryonic sphere without any divisions, and brought up until the complete formation of their polypary, which was affixed to the walls of the microscopic cells in which they were kept for observation, which enabled us to follow under the microscope a single embryo, of which the origin of the parts and the formation of the framework might thus be watched—and sometimes also upon very young individuals collected on the rocks of the localities inhabited by *Astroides* or *Balanophylliæ*.

VIII.—*On the Structure of the Skeleton of* Euplectella aspergillum. By Thomas Higgin, Member of the Liverpool Microscopical Society. (In a Letter to T. J. Moore, Curator of the Free Public Museum, Liverpool.)

[Plate III.]

[The specimen referred to in the following paper is one of two examples purchased of Mr. Geale in November 1866. It is 12 inches in length measured along the outer curve, and of a very uniform diameter of 1 inch. The other specimen is somewhat longer and stouter. Both are in a more natural condition than is seen in the examples usually submitted for sale; and both are of a pale brown colour. The smaller specimen is somewhat compressed towards the top, perhaps owing to pressure while drying; and nearly half the lid-like top is torn away, leaving a jagged edge, marring the beauty of the specimen. The lower third of the sponge is rigid, the rest soft and yielding throughout, the rigidity extending somewhat higher upon the inner than on the outer side of the curve.

It is, as Mr. Higgin supposes, the specimen referred to by Prof. Wyville Thomson in his "Letters from H.M.S. Challenger," published in 'Good Words' for July 1873, p. 510. On passing through Liverpool to Belfast in December 1868, he paid a hurried visit to the Museum, saw both examples, and I gave him a fragment from the smaller one for use under the microscope. It is remarkable that all the specimens

of *Euplectella* dredged by him off Cape St. Vincent should be uniformly in the condition indicated by the soft part of our sponge. His remarks are as follows:—

"Several samples of *Euplectella*, very closely allied to the Philippine species, if not identical with it, came up in the trawl off Cape St. Vincent, and gave us an opportunity for the first time of seeing this sponge alive. Dr. J. E. Gray writes to the 'Annals and Magazine of Natural History' that specimens have been received of *Euplectella aspergillum* in spirit, and that in these the glassy framework is entirely masked by a soft, brown, corky coating of sarcode. Our fresh specimens entirely bear out Dr. Gray's description. It would be difficult to imagine that the thick, somewhat clumsy brown tube, perforated with irregular openings, contained any arrangement of support so delicate and symmetrical.

"Although the forms of all the spicules, down to the most minute and complicated, are identical, the wall of the tube in the European specimens of *Euplectella* is not coherent as in most of the Philippine examples. The original spicules of the skeleton remain separate from one another, and do not become soldered together. One would think that this would be at all events a perfect specific distinction; but one or two of the specimens of *Euplectella aspergillum*, particularly one in the Museum at Liverpool, are in this condition; and I am not yet prepared to say whether all may not be thus soft at a particular stage of growth."

Mr. Higgin is well known in Liverpool for his great success in micro-photography. He has for some months been earnestly engaged in the study of sponges, and has kindly given this museum the benefit of his assistance in working up the tolerably numerous specimens already got together. It is a great pleasure and satisfaction to announce a new and zealous worker in a department of zoology so little cultivated, and in which there is so much work to be done.—T. J. Moore.]

Huyton, November 15, 1873.

My dear Mr. Moore,

The *Euplectella* which you have placed in my hands for examination is a very interesting and valuable specimen; for it reveals the composition of the network of these beautiful sponges, which I believe has not hitherto been exactly known.

Your sponge is rigid only to the extent of a few inches from the base, and is flexible throughout the rest of the tube. The cause of rigidity in *Euplectella* is the enclosure within a silicious coating of the spicules which form the fibres, which coating, for convenience' sake, has been called vitreous. This

vitreous coating being of the same nature as the spicules themselves, their outlines become lost to sight in it; it is impossible to distinguish them and trace their form and shape. Most, if not all, of the specimens which are brought to this country from the Philippine Islands are of this rigid character; and consequently the structure of the network remains undescribed. In your specimen, however, we have part of the network vitrified and part of it unvitrified; and in the unvitrified portion all the spicules are easily traceable and distinguishable, lying in the position they are destined to occupy in the rigid skeleton, ready for the silicious coating to be poured over them.

This, I understand, is the sponge to which Prof. Wyville Thomson alludes in his letter from the 'Challenger,' which appeared in the number of 'Good Words' for July last, where he speaks of the examples of *Euplectella* which were brought up in the trawl off Cape St. Vincent, the spicules of which were not soldered together, but were in the same condition throughout as those of a specimen of *Euplectella* in the Liverpool Museum. I learn, too, from Mr. H. J. Carter, of Budleigh-Salterton, that "Dr. Semper, of Würtzburg, had seen specimens of *Euplectella aspergillum* without any vitrified fibre, which he had viewed as young specimens in which the whole would have become vitrified if they had remained long enough in their natural place of growth—that, in fact, the flexible or unvitrified is the primary state of this species."

The groundwork of the square meshes is an arrangement of very large four-rayed spicules, the arms of which lie longitudinally and transversely; and so large are these spicules that they do not require to be measured under the microscope by the 100th or 1000th of an inch, but may be measured with an ordinary pocket-rule; each transverse arm extends over three to four of the square areas, so that from the tip of the one to the right to the tip of the one to the left is three quarters of an inch to an inch, and the longitudinal arms are still longer. I may here remark that these are genuine four-rayed spicules, and that at the central spot there is no appearance of suppressed arms. As the square areas only measure about one eighth of an inch each, it will be evident that the long arms of these spicules must extend towards each other, meet, and lie alongside one another, the tapering end of one extending up towards the thickest part of another. Along these interlocking arms are placed long, straight, and very slender spicules, which are spined from the extremities for a considerable distance along the shaft (Pl. III. fig. 7).

The diagonal lines and all the fine filaments are the long arms of four-rayed and six-rayed spicules, only three of

which, however, are usually produced, the other arms being more or less suppressed or abortive; the tips of the arms terminate in a kind of spear-head form which is spined; these arms are all extremely long, and some exceedingly slender, and they are twisted and bent in a variety of ways to suit the pattern of the network.

The open network of the mouth of the tube is composed of similar spicules interwoven together.

The exterior "ridges or frills" are also built up of spicules of the same form, the arrangement being that two or more long arms or rays lie along the network of the skeleton, whilst another arm, which is a short or dwarf one, stands up perpendicularly to the surface. These short upright arms are so placed as to form the lines of the ridges; and amongst them are interlaced the long slender rays of other spicules, in some of which all the transverse arms are suppressed. These ridges therefore contain the principle availed of in mechanical engineering in the ⊥ iron girder.

Interspersed throughout the whole of the network are numerous smaller sexradiate spicules, chiefly of slender form; but there are some with short stout arms which are quite smooth; the arms of the slender ones are all spined at the ends, and one of the longitudinal arms is usually produced to a great length.

The flesh-spicules are the "rosettes" of the two kinds described and figured by Mr. H. J. Carter in the November Number of 'Ann. and Mag. of Nat. Hist.' plate xiii. figs. 4 and 11, 1873.

Exteriorly there are bundles of long straight spicules or rods running along the longitudinal lines of the skeleton for some distance from the base, some of which are smooth, and others barbed.

It is a matter of great satisfaction to have met with a specimen of this species of sponge in which the vitrification is in progress: here it is actually so. In the lower part of the network to which the vitreous cement has been applied, it has been deposited in sufficient quantity to render the skeleton rigid, but not in such quantity or so completely as in the usual rigid examples. The examination of a portion, after boiling in nitric acid and subjecting to considerable heat, shows that the silicious coating has been deposited in layers, just as in the case of the spicules, the only difference, apparently, being that as cement it is amorphous, whilst in the spicules it assumes definite forms. The spicules of this species are, as Mr. Carter remarks, imbedded in vitreous material, much in the same manner as in the horny-fibred sponges the spicules are imbedded in horny material. In the Chalinæ, how-

ever, and sponges of that character, the enclosing material is added as the spicules are projected and placed in position, they being of a form not able to hold together without extraneous aid. But in the beautiful *Euplectella* we have what does not occur in sponges generally (if, indeed, it occurs at all in any other species)—that a structure is built up after a particular design which, when finished, is not added to, and which with slight variations obtains in all specimens: the wonderful basketwork made up by the interlacing or interweaving of the unusually long fine arms or rays of the various spicules is capable of holding together of itself by reason of its form; and the cementing material cannot advantageously be added until this is all complete; but when the whole structure has been finished according to the pattern which is constant in the species, the vitreous coating may be applied and the entire skeleton rendered rigid. Perhaps this silicious cement is not added in some localities; but in the examples from the Philippine Islands the unvitrified state appears to be, as Dr. Semper suggests, the primary state.

I am, dear Mr. Moore,

Yours very truly,

T. Higgin.

EXPLANATION OF PLATE III.

Fig. 1. 1. Large spicules forming ground-plan of the "squarish areas" or meshes, showing the position they occupy with respect to each other. Diameter of shaft at thickest point $\frac{1}{200}$ inch; length of each transverse arm about $\frac{3}{8}$ inch; length of each longitudinal arm about $\frac{3}{4}$ inch.

Fig. 2. One of the spicules of the diagonal lines, showing three arms only produced.

Fig. 3. A spicule, showing a suppressed arm and an abortive arm.

Fig. 4. A spicule, showing one of the various ways in which the arms are bent to suit the pattern.

Fig. 5. One of the spicules of the ridges or frills.

Fig. 6. A spicule, with all the transverse arms suppressed.

Fig. 7. 7. One of the fine straight spicules which lie along the arms of the large spicules, fig. 1. 1.

Fig. 8. One of the smooth stout sexradiate spicules interspersed amongst the network.

Fig. 9. One of the attenuate sexradiate spicules, spined at the ends of the arms, found interspersed amongst the network and sarcode.

Figs. 10 & 11. "Flesh-spicules," "rosettes."

The spicules 8 and 9 are very frequently found with the short longitudinal arm suppressed.

The figures represent the proportionate sizes of the spicules, with the exception of the smaller sexradiate forms, which are on a larger scale.

IX.—*Notes on* Pardalina Warwickii, *Gray*, Felis guigna, *Molina, and* Felis Geoffroyi, *D'Orbigny.* By Dr. J. E. Gray, F.R.S. &c.

Many years ago there was in the Surrey Zoological Gardens an animal shown as the "Himalaya Cat," which is figured by Colonel Hamilton Smith in Jardine's 'Naturalist's Library,' but not very characteristically, under the name of *Felis himalayana*, Warwick. When the animal died it was preserved in the British Museum, and recorded in the 'List of Mammalia in the British Museum,' published in 1842, under the name of *Leopardus himalayanus*. Mr. Blyth, in the "Species of the genus *Felis*" (P. Z. S. 1863, p. 184), puts *F. himalayana* of Warwick as a synonym of *Felis viverrina*, Bennett, and, not recollecting that Warwick's cat and the one in the Museum were the same specimen, he puts in "not of Gray;" and in a note he says, "*F. himalayana* is perhaps *F. celidogaster* of Temminck," which he gives as a synonym of *Felis viverrina*, Bennett. In fact the synonyma are the regular confusion of a compiler, which is easily to be understood and apologized for in Mr. Blyth's case, but should be a caution to compilers.

When this cat was alive it was just the time that we began to receive fine skins of animals from the Himalayas; and there was an inclination of the dealers to give Himalaya as the habitat of animals of which they did not know whence they came, as animals from that country were interesting and fetched a good price; but numerous collectors and sportsmen who have searched that country assure me that the cat is not found there, or at least has not occurred to them; and it has been suggested by Mr. Blyth and others that it may be an inhabitant of South America; but I have not seen any specimens from there.

In the 'Proc. Zool. Soc.' for 1867, on account of the length of the brain-case of the skull, and shortness of the face and convexity of the forehead, I formed for this cat a genus under the name of *Pardalina*, and gave it the specific name of *Warwickii*, because the name of *himalayanus* might lead to misconception, and figured the skull (P. Z. S. 1867, p. 267, fig. 4; and Cat. Carniv. p. 15, fig. 4).

D'Orbigny and Gervais, in the 'Bull. Soc. Philomat. Paris,' 1844, p. 40, and in the 'Voy. Amér. Mérid.' p. 21, t. xiv. (animal), & t. xiii. fig. 1 (skull), figure a cat from Rio Negro, in the pampas of Buenos Ayres, under the name of *Felis Geoffroyi*, which they compare to the Ocelot Chati and Margay, and to the *Felis guigna* of Molina, which I had not thought of comparing with it when I wrote the paper in the 'Proceedings,' not thinking it likely that a cat from India and one from

South America were the same; but Dr. Sclater (P. Z. S. 1870, p. 796) observes:—"The so-called *Felis Warwickii* being now dead, I have been able to examine it more carefully, and find it to belong to a well-known South-American species, *Felis Geoffroyi* of D'Orbigny and Gervais;" and this theory is adopted by Mr. Elliot (P. Z. S. 1872, p. 203).

The specimen of *P. Warwickii* and the figure of *F. Geoffroyi* bear a general resemblance, but they appear to me very different. The specimen in the Museum is much more spotted, and the spots of the back are smaller and more numerous; the throat, chest, and belly are largely spotted. The throat is said to be whitish in M. d'Orbigny's description; and the belly of of his figure is not spotted at all; but this might be a variation, though I should not think it probable.

M. Gervais figures the skull of the South-American cat; and when his figure and the figure of the skull of *Pardalina Warwickii* are compared, and his figure with the skull itself, though they agree in the length of the brain-case, they differ greatly in the form and outline of the face, and especially in the outline of the lower jaw; so that I have little doubt that they are distinct, though both may belong to the genus *Pardalina*.

Molina, in his work on Chili, described a species under the name of *Felis guigna*. MM. d'Orbigny and Gervais asked, "Mais qu'est-ce que c'est que le *Felis guigna?*" Dr. A. Philippi has described and figured this species and its skull in Wiegmann's 'Archiv f. Naturg.' 1873, p. 8, t. ii. (animal), & t. iii. figs. 2 & 3 (skull). The figure of the animal nearly agrees with the figure of *Felis Geoffroyi*, and differs from the specimen of *Pardalina Warwickii* in the Museum in the fewness of the spots on the neck, and in the chest and belly (according to both figure and description) being white and spotless. The skull figured is that of a young animal, and appears to differ only in age from that figured by D'Orbigny and Gervais; and there can be no doubt that *Felis Geoffroyi* of D'Orbigny and Gervais is the same as *F. guigna* of Molina and Philippi.

Therefore the synonyma of the species will run thus:—

Pardalina Warwickii.

Belly closely spotted.

Felis himalayanus, Warwick, Jardine's Naturalist's Library, t. xxiv.
Pardalina Warwickii, Gray, Proc. Zool. Soc. 1867, p. 257, fig. (skull); Cat. Carniv. p. 15, fig. (skull).
Felis Geoffroyi, Sclater, Proc. Zool. Soc. 1870, p. 796; Elliot, Proc. Zool. Soc. 1872, p. 203.

Hab. Unknown.

The British Museum has just received from Mendoza, in the Argentine Andes, a small female kitten of this species. The back has very numerous small brownish spots, and the belly is covered all over with many larger black spots like the adult. It is very different from D'Orbigny's figure of *Felis Geoffroyi* from the Pampas and Philippi's *Felis guigna*, which have a plain white belly.

Pardalina? guigna.

Belly white, spotless.

Felis guigna, Molina, Chili; Philippi, Wiegm. Archiv f. Naturg. 1873 t. ii. figs. 1 (animal), 2, 3 (skull).
Felis Geoffroyi, D'Orbigny, Voy. Amér. Mérid. p. 21, t. xiii. (animal), t. xii. f. 1 (skull).

Hab. Pampas, Buenos Ayres.

Mr. Elliot, in 'Proc. Zool. Soc.' 1872, states that the typical specimen of *Felis pardinoides*, Gray (P. Z. S. 1867, p. 400, & Cat. Carniv. B. M. p. 27), is a young specimen of *Felis Geoffroyi*, which he identified with a young specimen marked *F. Geoffroyi* in the museum at Leyden, observing that "the general colour of the animal, with its lengthened annulated tail, is precisely that of the typical *F. Geoffroyi*," adopting Mr. Sclater's opinion that "the *Pardalina Warwickii*, Gray, is also *F. Geoffroyi*," and that "the synonymy of this species will therefore be somewhat as follows," in which he makes all these one species.

The specimen of *Felis pardinoides* here referred to was received from the Zoological Society's museum in 1855, marked as having been presented to the Society by Capt. Innes and as coming from India, as recorded in the 'Proc. Zool. Soc.' 1867, p. 400, and 'Catalogue of Carnivora in the British Museum,' p. 27. I have named the animal *Felis pardinoides*, because the form of the spots with a light centre has a certain resemblance to those of the American ocelots. I will not undertake to vouch for the accuracy of the habitats we receive from the Zoological Society; the Indian habitat has not been confirmed; and the species has a very South-American aspect. The specimen has not the slightest resemblance in its general coloration to the specimen of *Pardalina Warwickii* in the Museum, or to the figure of *Felis Geoffroyi* of D'Orbigny's 'Voyage.' I think it will be an astonishment to every one who has the slightest pretension to be a zoologist that they should have been regarded as belonging to the same species.

We received from the Zoological Society along with the specimen of *Felis pardinoides* the skull belonging to it, which is described in the 'Proceedings' and 'Catalogue.' This skull has a sloping forehead and a well-developed face, quite different from the skull of *Pardalina Warwickii*, more like the skull of an ocelot, showing that it has no relation whatever to the genus *Pardalina*. It is true that it shows the animal is not aged; but the skull is perfectly developed, and is evidently that of a fully grown animal, and therefore does not justify Mr. Elliot's assertion that the "typical specimen is not an adult animal."

It is greatly to be regretted that Mr. Elliot did not take the trouble to compare the two skulls in the Museum before he made such a random assertion as that *F. pardinoides* is the same as *F. Geoffroyi*.

Pardalina Warwickii and the figure of *Felis guigna* have an immense number of small, rather unequal-sized, moderately closely placed solid black spots on the upper part of the body; those near the centre of the back are smaller, but not united into lines: and *P. Warwickii* has larger spots on the under-side of the body, which are largest in the central line; these, according to the description and figures, are entirely wanting in *Felis guigna*. The tails are cylindrical and blunt at the end.

Felis pardinoides, on the contrary, has large-sized spots of a squarish form, with a pale centre, placed in about four series, more or less interrupted or irregular, on each side of the body; the vertebral line is marked with a narrow continuous line, which is forked, and more or less continued in front between the shoulders, and with a series of spots on each side of it, which are much smaller than those on the sides of the body; the tail is rather thick, the hinder half tapering to a point. The spot with the pale centre sometimes shows a likeness to the "rose" (that is to say, the spot formed of a ring of small spots with a pale centre) found in the American cats; hence the name of *pardinoides*. There is nothing of this kind to be seen in *P. Warwickii*, where the small spots are all equally separated.

X.—*Notes on the Smaller Spotted Cats of Asia and its Islands*. By Dr. J. E. Gray, F.R.S. &c.

Mr. Blyth, in his paper on the Asiatic species of the genus *Felis* (P. Z. S. 1863, p. 184) regards *Felis nipalensis* and *F.*

pardichrous of Hodgson, *F. wagati* of Elliot, *F. nipalensis* of Vigors and Horsfield, *Leopardus Ellioti*, *L. chinensis*, *L. Reevesii*, and *Chaus servalinus* of Gray as all varieties of one species, which he calls *F. bengalensis*, Desmarest, and *F. minuta*, Temminck; and he considers *Felis Jerdoni* a distinct species. I may observe that *Leopardus Ellioti*, differing from the other species by its skull (which has a complete orbit), belongs to the genus *Viverriceps*, and is therefore out of the question.

Mr. Daniel Elliot is of opinion that *Felis Jerdoni*, Blyth, is only a variety of *Felis rubiginosa* (P. Z. S. 1871, p. 760). It has not the long head of a *Viverriceps*, to which *F. rubiginosa* belongs, and is much more likely to be a variety of *F. minuta*, which I considered it in the 'List of Mammalia,' 1842, p. 43. He also decides that *Felis pardinoides*, received from the Zoological Society as coming from India, is the young of *F. Geoffroyi* from the pampas of South America (P. Z. S. 1872, p. 203); but we have the skull of this cat (which Mr. Elliot could not have observed, though it is mentioned in the Catalogue), which shows that it entirely differs from the skull of *Pardalina Warwickii*, which he considers the same as *Felis Geoffroyi*, or from D'Orbigny's figure of the skull which appears to belong to the genus *Pardalina*.

I will not vouch for the distinctness of all the species I have entered in the 'Catalogue of Carnivora in the British Museum;' for the progress of science, aided by the collection of more specimens and the study of their changes, may prove some of them to be only varieties of others; but they appear, according to our present knowledge of the specimens and their distribution, to be worthy of being reckoned as distinct species.

The specimens in the Museum may be arranged thus:—

I. *Tail cylindrical, shorter than the body, and marked with black spots. The body with subequal spots, sometimes united on the dorsal line.*

a. *The body with a multitude of small spots*—those on the shoulders and outside of the limbs being the largest, those on the middle of the back between the haunches and, especially, between the shoulders being united into four or six narrow lines. China and Siberia.

Felis chinensis, Gray, Cat. Carniv. p. 27. no. 22.

Hab. China (*Reeves*). B.M.

Felis euptilura, D. Elliot, P. Z. S. 1871, p. 761, t. lxxvi.

Felis undata, Radde, Reisen im Süden von Ost-Sibirien, p. 100, t. iv.

Hab. Siberia? B.M.

This species is described from a skin in a very bad state in the British Museum, which Mr. Bartlett, from whom we received it, believed came from Siberia. Mr. Daniel Elliot (P. Z. S. 1871, p. 758), without giving any authority, calls it a species from "North-*western* Siberia." The markings of the skin are difficult to make out from its state; but I have no doubt Mr. Wolf studied it very particularly when he made the figure. The figure is very like that of *Felis chinensis*; but the spots on the back are not so numerous and small, and those on the underside are large and distinct. Otherwise I should have considered it a specimen of that species.

Mr. D. Elliot considers this skin of a cat the same as the one that Radde collected in Amurland, in *Eastern* Siberia, and figured and described in his 'Reisen im Süden von Ost-Sibirien' under the name of *Felis undata*, Desmarest, and *F. minuta*, Temminck, from Java; and he considers *F. chinensis*, from China, the same species. Radde's figure is very unsatisfactory. It would be desirable to receive specimens from the Amurland to see if the Chinese and Siberian specimens are the same, or how they differ, and if the same as the skin in the British Museum that Mr. D. Elliot has named and figured.

b. *Body with five or six lines of oblong spots*—those on the middle of the back being very narrow and elongate, with two stripes on each side above the shoulder, those on the sides being larger and oblong, and on the outside of the limbs roundish. Malay archipelago.

† *Spots of body small and oblong. Fur short, rather harsh.*

Felis javanensis, Cat. Carniv. p. 26. no. 20.

Hab. Java (*Dr. Horsfield*). B.M.

Felis Jerdoni, Cat. Carniv. p. 28. no. 26.

Hab. Java? B.M.

Felis Jerdoni was named by Blyth in the 'Proc. Zool. Soc.' 1863, p. 185, from two specimens in the museum at Madras and an adult specimen in the British Museum. In the Catalogue I have adopted Blyth's name for this specimen, which was received from the India House, and probably came

from Sumatra, Dr. Horsfield calling it *Felis sumatrana*; and I placed with it another specimen received from Jeude's collection in Holland under the same name. The two specimens agree in having a short scarcely spotted tail, and may be a variety of that species. Mr. Elliot (P. Z. S. 1871, p. 760) observes that "Blyth's species [*F. Jerdoni*] is only a dark form of *F. rubiginosa*," and says that Mr. Blyth agrees with him!

How any zoologist could believe that the short-tailed short-headed *Felis Jerdoni*, with distinct spots, could be the same as the long-tailed, long-headed, and striped *Felis rubiginosa* is a mystery to me. I believe that their skulls would show that they belong to different genera. The long-headed *Felis rubiginosa* has a long, very peculiar skull, with complete orbits, and belongs to the genus *Viverriceps*, to which *Felis Jerdoni* shows no relation.

†† *Spots of body elongate, larger. Fur soft.*

Felis minuta, Cat. Carniv. p. 26. no. 19.

Felis sumatrana, Horsfield.

Hab. Sumatra. B.M.

Felis Herschelii, Cat. Carniv. p. 28. no. 27.

Felis servalina, Gray, P. Z. S. 1867, p. 401.

The spots as in *F. minuta*, but smaller and further apart, and the ones on the shoulder larger and confluent, and on the hinder part of the dorsal line in broader lines.

Hab. India? B.M.

The spots are somewhat like those of the next section; but the tail is short, like that of the Sumatran cat.

II. *Tail cylindrical, blunt, as long as the body, with dark, more or less confluent spots. The body with irregular-shaped dark blotches.* Continental India.

a. *The blotches of the body oblong, solid, or very nearly so.*

Felis wagati, Cat. Carniv. p. 29. no. 28.

Hab. India. B.M.

Felis pardochroa, Cat. Carniv. p. 28. no. 24.

Hab. Nepal. B.M.

Felis tenasserimensis, Cat. Carniv. p. 28. no. 25.

Hab. India, Tenasserim. B.M.

b. *Spots on the body larger, squarish, and pale in the centre.*

Felis nepalensis, Cat. Carniv. p. 27. no. 21.

Hab. India. B.M.

Perhaps a domesticated or semiwild hybrid between the Indian wild species and the common cat.

III. *Tail tapering at the end, nearly as long as the body, with distinct black rings and a black tip.*

Felis pardinoides, Cat. Carniv. p. 27. no. 23. B.M.

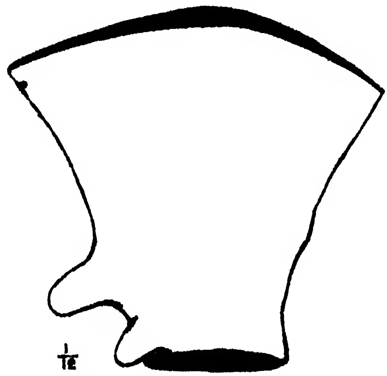
If this species was brought from India by Capt. Innes, as it was stated, and the habitat which we received with the specimen from the Zoological Society correct, it belongs to this section; but it has much more the appearance of a South-American cat; indeed it has a good deal of resemblance to *Felis mitis*. At any rate, it is distinct from any other Indian cat; and we must await the determination of its proper geographical distribution until we have received other specimens with their proper habitat. Mr. Elliot has stated that he believes it to be a specimen of *Felis Geoffroyi* from the Pampas. I have given my opinion on this crude and extraordinary idea in a previous paper in this number of the 'Annals' (p. 49), with a description of the peculiarities of this species.

XI.—*On the Bladebones of* Balæna Hectori *and* Megaptera novæ-zelandiæ. By Dr. J. E. Gray, F.R.S. &c.

I have received from Dr. Hector the drawings, one twelfth of the natural size, of the scapulæ of two whales, which he collected at Tory Channel, New Zealand.

The smaller one (see figure, p. 57) is about two feet high and an inch or two wider at the upper edge. The whalers said it was the scapula of a humpback; but this must be a mistake; for it certainly has nothing to do with the scapula of *Megaptera novæ-zelandiæ* (the New-Zealand humpback). The scapulæ of the humpback or fin-whales are always much broader than high; this is the scapula of a true *Balæna*, and has a distinct acromion process, which is bent towards the condyle, as in the scapula of *Macleayius australiensis* figured by me from a specimen in the British Museum sent by Dr. Haast from New Zealand (P. Z. S. 1873, p. 140). I should think it was probably a specimen of this species; but the upper margin is not quite so broad and expanded, and the figure appears to show

a short, thick, conical coracoid process near the glenoid cavity, which would lead to the idea that it is a distinct species not hitherto recorded as occurring in New Zealand. I propose to call it *Balæna Hectori.*



Bladebone of *Balæna Hectori.*

I call this species *Balæna* because I do not know any of the existing genera to which it can be referred, and think that when we know more of the skeleton to which it belongs it will most probably be the type of a new genus of Balænidæ.

This bladebone, from its small size, may be that of *Neobalæna marginata*, the pigmy New-Zealand whale, which was first known from three blades of whalebone, then from its ear-bone, and at last by the discovery of the whole skull; but the rest of the skeleton is still unknown; and the possession of an acromion process to the scapula, which is not found in any other true whale, would agree with the anomalous form of the bones of the head of that whale.

The other drawing represents a scapula about 2½ feet high and 4 feet wide at its upper edge, which the New-Zealand whalers said belonged to the black whale; and Dr. Hector says it agrees with the scapula that Dr. Knox gave to the museum of the New-Zealand Institute just before he died as that of the black whale. It doubtless belonged to the whale which he so called in his papers.

This figure represents the scapula of a species of *Megaptera*; for it agrees with it in its broad oblique outline, and in being destitute of any coracoid or acromion process, or any rudiments of them, like the rudimentary acromion process found in the *Poescopia Lalandii* of the Cape seas. It is most probably the scapula of the *Megaptera novæ-zelandiæ*, Gray (Cat. Seals and Whales, p. 128, fig. 20), which I established on an ear-bone

and *os petrosum* brought from New Zealand. This bladebone, although it agrees in general form with that of the European species, differs from it in the outline being more oblique, having the front edge of the scapula more erect, and the back edge lower and more directed backwards than in the bladebone of *Megaptera longimana* of the North Sea and North Atlantic Ocean.

BIBLIOGRAPHICAL NOTICES.

Mammalia, Recent and Extinct. An Elementary Treatise for the use of the Public Schools of New South Wales. By A. W. Scott, M.A. Sydney: Thomas Richards, Government Printer, 1873. 8vo, pp. 141 and xix. Price 2*s*. 6*d*.

The Preface informs us that "The following pages, briefly descriptive of the economy of Seals, Dugongs, and Whales, and of their principal fossil allies, form the second part or Section B of an 'Elementary Treatise on the Mammalia,' designed for the use of the more advanced pupils in the Public Schools of this country under the direction of the Council of Education.

"Whatever information we possess upon the natural history of the finned mammals, particularly in a popular yet scientific form, has been so scantily and unequally distributed, that in this direction a comparatively new field may be said to be open to the teacher as well as to the youthful inquirer.

"Influenced also by the great commercial value of the Pinnata, I have felt anxiously desirous to direct without further delay the attention, and thus possibly secure the sympathy, of readers other than students to the necessity of prompt legislative interference in order to protect the oil- and fur-producing animals of our hemisphere, or at least some of them, against the wanton and unseasonable acts committed by the unrestrained trades—and thus not only to prevent the inevitable extermination of this valuable group, but to utilize their eminently beneficial qualities into a methodical and profitable industry.

"Keeping steadily in view these two objects, whose importance I trust will bear me out in deviating from my original intention in the order of the issue of publication, I have endeavoured:—first, to interest the youthful mind with selections of well authenticated anecdotes of the general habits of these peculiar animals, accompanied, however, by those drier details of structural characters essentially requisite to assist the more advanced and thoughtful student to a better understanding of the generic distinctions, and to aid him as a work of reference or descriptive catalogue, should he be disposed in after-life to prosecute his researches in this difficult and

imperfectly understood branch of zoology; and, secondly, by devoting as much space as my limits would permit to the consideration of the animals whose products are of such commercial value to man, and whose extinction would so seriously affect his interests, and to point out the pressing necessity that exists for devising protection for the fur-seals and the sperm and right whales of the Southern Ocean."

This work is far more than its title and cheap price would lead one to expect. It is a scientific and popular account of all known seals, whales, and dolphins, far more complete than any English or Continental work that I am acquainted with.

The catalogues of the British Museum are the basis of the work, as far as regards the recent species; the observations on the history and habits of the animals are very well compiled; and we look forward to the continuation of the work with great pleasure. I will make two suggestions to the author.

I think it is to be regretted that the author of this work, intended for the use of schools, should have occupied so much space with giving the synonyms of the species, a subject very interesting to scientific zoologists, but of no importance to even advanced pupils. Secondly, it would be much better if the author, who evidently has little practical means of judging for himself, placed more confidence in the descriptions from real specimens.

In his account of the southern fur-seals, for example, which is a subject particularly interesting to the Australians, he has been misled by Mr. Allen's observations, when describing some seals of the Northern Pacific, into believing that all the southern fur-seals belong to one species, while Mr. Allen admits that at the time he wrote he had not examined a single fur-seal from the southern hemisphere, but *thought* they were all one species; whereas I have come to a different conclusion, having under my care two stuffed skins, five unstuffed skins, and two skulls of *Arctocephalus antarcticus* from the Cape of Good Hope, four stuffed skins and four skulls of *Arctocephalus nigrescens* from the Falkland Islands, a skull of *Arctocephalus cinereus* from New Zealand, a stuffed specimen and a flat skin of *Arctocephalus falklandicus* from the Falkland Islands (which Mr. Scott has done me the honour to call *A. Grayi*), and two stuffed skins and two skulls of *Gypsophoca tropicalis* from North Australia; and I believe that if Mr. Allen had had the opportunity of examining these specimens he would have changed his opinion. While the author puts all these seals under two names, he describes as new a "top-knot seal" from Patagonia under the name of *Arctocephalus sulophus*, from the notes of a sealer!

It is to be observed that not only do the species above mentioned differ in the form of their skulls, and in general size, proportion of parts, and colour, but also the skins from the Falkland Islands, Australia, and the Cape bear different prices in the market, and are at once known by the furmonger.—J. E. Gray.

Ostéographie des Cétacés, vivants et fossiles. Par MM. van Beneden et Paul Gervais. Livraisons 9 & 10. Texte & Atlas.

It is with great pleasure that I announce that I have received the ninth and tenth livraisons of this work, which I feared had been stopped by the French and German war; and I hope that the work will now proceed regularly. The parts contain the completion of the text of the description of the plates of the *Mysticètes*, and is signed by P. J. van Beneden, and the commencement of the text of the *Cétodontes*, and the description of the genus *Cachalot* (*Physeter*). The plates all belong to the *Cétodontes*, and are marked as having been prepared under the superintendence of M. P. Gervais. In the previous notice of this work, entitled "Observations on the Whales described in the 'Ostéographie des Cetacés' of MM. van Beneden and Gervais," in the 'Annals,' Sept. 1870, vol. vi. p. 193, I gave the history of it, saying that the book was undertaken and published at the cost of my esteemed friend M. van Beneden, and the text written by M. Gervais, which I did on the authority of a conversation with M. Gervais. M. van Beneden, when he called upon me shortly after in London, informed me that the book was published at the expense of the publisher (was in fact a bookseller's speculation), and the description of the plates of the whales was written by him for the publisher. I offered to make the correction in the next number of the 'Annals;' but he begged me to let it remain as it was; and believing that he might have a private reason for his request, I obeyed his injunction. But very shortly after M. van Beneden's return to Louvain he published a statement as if I had never made the offer. He now signs the end of the description of the *Mysticètes*, or Whalebone-Whales; and if the part which each author took in the superintendence of the work had been stated in the prospectus, this mistake would not have occurred.—J. E. Gray.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 19, 1873.—William Spottiswoode, M.A, Treasurer and Vice-President, in the Chair.

"On the Organization of the Fossil Plants of the Coal-measures.—Part V. *Asterophyllites.*" By W. C. Williamson, F.R.S., Professor of Natural History in Owens College, Manchester.

On two occasions the author directed attention, in the Proceedings of the Royal Society (vol. xx. pp. 95 & 435), to the structure of some stems which appeared to him to belong to the well-known genus *Asterophyllites*, briefly pointing out at the same time their apparent relations to a strobilus of which he had pre-

viously published figures and descriptions (Transactions of the Literary and Philosophical Society of Manchester, third series, vol. v. 1871) under the name of *Volkmannia Dawsoni*. In the present memoir he gives a detailed exposition of the various parts of the plant, including the roots, rootlets, stems, branches, leaves, and fruit, in different stages of their development. This is done chiefly in two modifications of the primary type—one from the Lower Coal-measures of Oldham in Lancashire, the other from those of Burntisland. In its youngest state, the Oldham form first appears as a mere twig, having a central fibro-vascular bundle enclosed in a double bark. The vascular bundle consists entirely of vessels which are chiefly, if not wholly, of the reticulated type. When divided transversely, it presents a triangular section, the triangle having long narrow arms and very concave sides. The bark is already differentiated into two layers, and has its exterior deeply indented by three lateral grooves—one opposite to each concave side of the vascular triangle. The outer layer is prosenchymatous, with vertically elongated cells; the inner one consists of cylindrical parenchyma arranged in radial lines, the cells being also elongated vertically. As the plant grew, successive vascular layers were added exogenously to the exterior of the vascular axis. Each layer consisted of a single linear row of vessels, which were of large size opposite the concavities of the triangle, and small where they approached its several angles. The radial arrangement of those in the several growths was equally regular; they were disposed in single radiating series, new laminæ being intercalated peripherally as the stem grew. These radiating laminæ were separated by small medullary rays. Owing to the fact mentioned, that the laminæ radiating from the concave sides of the central triangle consisted of much larger vessels than those radiating from its angles, three or four such growths sufficed to convert its concave sides into slightly convex ones, whilst a few more such additions converted the vascular axis into a solid *cylindrical* rod. At this stage its transverse sections appeared definitely divided into six radiating areas—three of large open vessels radiating from the sides of the primary triangle, and three of small ones proceeding from the sides and extremities of the angles. When these growths have thus given a cylindrical form to the vascular axis, a change takes place in its further development. Concentric growths again begin to form; but in them all the vessels are of almost equally small diameters: hence the abrupt termination of the three areas of large vessels in the younger growths produces a distinct circular boundary line, marking a special stage in the genesis of the stem. From this point the additions go on uninterruptedly, the vessels of each radiating lamina or wedge increasing slowly in size from within outwards as the stem advances towards maturity. During these further developments the bark has continued to be separated into two well-defined forms. An inner layer consists of very delicate elongated cells with square ends (prismatic parenchyma); these are seen in the transverse section arranged in ra-

diating lines proceeding from within outwards. The outer bark consists of narrow, elongated, prosenchymatous cells, having very thick walls; at intervals, corresponding with the spaces between the successive verticils of leaves in the ordinary examples of *Asterophyllites*, we find distinct nodes where the bark expands into lenticular disks. The vascular axis passes through these nodes without undergoing any visible change, either in the position of its vascular layers or in giving off vessels to the nodes or their appendages. The thin peripheral margin of each node sustains a verticil of the slender leaves of *Asterophyllites*, of which there are about twenty-six in each verticil. The aspect, dimensions, and arrangements of these leaves correspond exactly with what is seen in the ordinary specimens found in the coal-shales. Transverse sections of them exhibit a single thick central midrib, but no traces of vascular tissues have hitherto been found in them.

The laminæ of the vascular axis are separated by numerous medullary rays of small size; these rarely exhibit more than four or five cells in any vertical series, and usually but one or two. The exterior of the bark is deeply indented in each internode by three very deep superficial grooves, each one of which occupies the side of the stem corresponding with a concavity of the central triangle of the vascular axis. These grooves, which are sometimes double instead of single, extend from node to node, but do not indent the nodal disks. Owing to the great depth to which these penetrate the bark, they give a very characteristic tripartite aspect to each transverse section of these stems.

The Burntisland type agrees with the Lancashire one in all its leading features of structure and growth; but its vessels are all barred instead of being reticulated, and the author has not met with such beautiful examples of its nodal disks as he has done in the case of the other form; neither has he seen its leaves attached. On the other hand, he has found specimens of much larger diameter than any that have hitherto been detected in Lancashire, exhibiting in an exquisitely beautiful manner the characteristic peculiarities already referred to. The author has also obtained one section from this locality in which a branch is given off. The vessels of this divergent organ are derived from the central portion of one of the segments of small vessels, seen in the transverse sections, which proceed from one of the angles of the central triangle.

Having elucidated the details of the aërial stems, the author proceeds to examine such organs of fructification as appear to belong to these plants, commencing with the *Volkmannia Dawsoni* which he described at length in the Transactions of the Philosophical Society of Manchester in 1871. This is a verticillate strobilus with a central vascular axis, of which latter transverse sections exhibit a close correspondence with the triangular bundle of *Asterophyllites*, being also triangular, with concave sides and truncate angles. But in order to adapt this primary fibrovascular bundle to the requirements of the fruit, each of the truncate angles is

enlarged, so as to make the entire section an almost hexagonal one. This axis is surrounded, as in *Asterophyllites*, by a double bark—an outer prosenchymatous one, and an inner one of more delicate cellular structure. At each node this bark expands into a lenticular disk fringed with stiff narrow bracts, which extend upwards and outwards beyond the sporangia. The latter rest upon the bractiferous disks and the basal portions of the bracts, each verticil being fertile. The sporangia are closely packed in about three concentric circles, and attached by sporangiophores originating from each side of the base of each bract. The sporangia have cellular walls; they are full of large spores, each of which has its surface prolonged into a number of very long radiating spines. This fruit the author unhesitatingly identifies with the aërial stems previously described.

He then examines various so-called *Volkmanniæ* found in the Lancashire Carboniferous shales, of which the internal structure is not preserved, but which, being found with leaves attached to them, admit of no doubt as to their belonging to *Asterophyllites*. These are regarded as being identical with *Volkmannia Dawsoni*; hence the author accepts the latter fruit as giving the internal organization of the ordinary Asterophyllitean strobilus. The fruit (which has been previously described by Binney, Carruthers, and Schimper, under the names of *Calamodendron commune*, *Volkmannia Binneyi*, and *Calamostachys Binneyana*) is then investigated. The above authors had associated it with *Calamites*; but its internal structure is shown to have nothing in common with that type. It consists of alternating verticils of barren and fertile appendages. The former are nodal disks bearing protective leaves; the others are verticils of sporangiophores, usually six in each verticil, and which closely resemble those of the recent Equisetaceæ; they project at right angles from the central axis, and expand at their outer extremities into shield-like disks, which sustain a circle of sporangia on the inner surface of each shield. The sporangia consist of a very peculiar modification of spiral cells; they are filled with spores which have been described as provided with elaters, like those of *Equisetum*; but the author rejects this interpretation, regarding the so-called elaters as merely the torn fragments of the ruptured mother cells in which the true spores have been developed. The vascular axis is shown to be *solid*, and without any cellular elements, being wholly different from that of *Calamites*, in which the vascular axis is a *hollow* cylinder containing an immensely large cellular and fistular pith. In one fine example of *Calamostachys Binneyana* the author has found the central fibro-vascular bundle surrounded by an exogenous ring. This, too, exhibits no resemblance whatever to the corresponding growths of *Calamites*; on the other hand, it corresponds closely with conditions occurring in some parts of *Asterophyllites*, to which group the author believes the fruit to be related, notwithstanding the peculiarity of its sporangia and sporangiophores. The author is confirmed in his conclusion that this fruit is not Cala-

mitean by his having already described the structure of a true Calamitean strobilus from an example in which the central axis retains most accurately the arrangement of tissues characteristic of Calamitean stems (Manchester Transactions, 1870). A type of stem to which the author had previously assigned the provisional generic name of *Amyelon* is now shown to be the root or subterranean axis of *Asterophyllites*, specimens being described in which clusters of rootlets are given off, in irregular order, from various points of the exterior of the branching roots. The latter have no medulla; but in the centres of several of them the author finds the peculiar triangular fibro-vascular bundle so characteristic of *Asterophyllites*; and remains of the same trifid origin of the vascular layers may be traced in all, in the peculiar curvatures assumed by the vascular laminæ as they proceed from within outwards. The bark consists of two layers: the inner one is composed of ordinary parenchymatous cells, often of considerable size; the outer one consists of irregular piles or columns of cells, disposed perpendicularly to the surface of the bark, and with their tangential septa in close contact and in parallel planes. The lateral or radial boundaries of these piles of cells are more strongly defined than the transverse septa. In tangential sections of this outer bark, each of these radially disposed columns of parallel-sided cells appears as a single thick-walled parenchymatous cell, whose aspect, in common with that of its neighbours, is that of ordinary coarse parenchyma. Such sections exhibit no indication of the radial elongation of these cells seen in radial and transverse ones. On reexamining the inner bark, we discover the explanation of these appearances. Many of the larger and more peripheral of the cells of the latter are seen to be undergoing division by the development within their walls of secondary cell-partitions, which are parallel with those of the radially disposed columns. It appears obvious that each of the latter was primarily one of the cells of the inner bark, which has become elongated radially, and at the same time divided into a linear series of compressed cells by the growth of a succession of secondary divisions, all of which were more or less tangential to the periphery of the stem.

The author directs special attention to the genetic activity of this inner bark; the cells of its inner surface were obviously instrumental in producing the successive circumferential additions to the primary vascular axis, whilst those of its outer surface increased the diameter of the outer bark in the way just described.

After comparing these plants with living forms, the conclusion is arrived at that the nearest parallel to the structure of their stems is to be found in *Psilotum triquetrum*; whilst their general affinities are regarded by the author as Lycopodiaceous rather than Equisetaceous. The exogenous aspect of their successive vascular growths is, if possible, more conspicuous than in most of the other Carboniferous Cryptogams.

The structure of the stems described is identical with that of those found at Autun by Prof. Renault, and assigned by him to

Sphenophyllum; thus the close affinity of this genus with *Asterophyllites* appears to be finally established. The *Calamites verticillatus* of authors is probably the arborescent stem of one of these plants.

"On a newly discovered extinct Mammal from Patagonia (*Homalodotherium Cunninghami*)." By WILLIAM HENRY FLOWER, F.R.S.

The author describes the complete adult dentition of a new genus of mammal, founded on remains discovered by Dr. Robert O. Cunningham in deposits of uncertain age on the banks of the River Gallegos, South Patagonia. The animal appears to have possessed the complete typical number of teeth, *i. e.* twenty-two above and below, arranged in an unbroken series, and of nearly even height, and presenting a remarkable gradual transition in characters, in both jaws, from the first incisor to the last molar. The molars more nearly resemble those of the genus *Rhinoceros* than of any other known mammal; and, judging only by the general characters of the teeth, the animal would appear to have been a very generalized type of Perissodactyle Ungulate, allied through *Hyracodon* (a North-American Miocene form) to *Rhinoceros*, also more remotely to *Macrauchenia*, and, though still more remotely, to the aberrant *Nesodon* and *Toxodon*. The generic name *Homalodotherium* was suggested for this form by Professor Huxley in his Presidential Address to the Geological Society in 1870.

MISCELLANEOUS.

On the Sterile Eggs of Bees. By C. CLAUS and C. VON SIEBOLD.

THE existence of fecundated queen bees laying sterile eggs was ascertained incontestably some years ago; but no certain explanation had been given of this abnormal fact. M. von Berlepsch indeed had suggested that cases of this kind must be ascribed to some pathological state of the female; but no positive observations had been made on this subject. Some opponents of parthenogenesis, such as still exist in France, thought that the sterile eggs were laid by unfecundated queens. The observations of MM. Claus and von Siebold finally settle the question, and will compel those bee-keepers who will not accept the facts of parthenogenesis to seek other arguments.

The first case observed by M. Claus was that of an Italian queen born in the middle of May and beginning to lay in the middle of June. From this period she continued to deposit eggs until the 5th of October; but none of the eggs gave birth to larvæ. If this queen had been constructed normally but had not been fecundated in May, she ought at least to have produced males by parthenogenesis. Dissection proved that the oviducts and copulatory organs were per-

fectly normal, and that the seminal receptacle swarmed with spermatozoids. On the other hand the ovarian tubes, although scarcely reduced in size and number, showed a degeneroscence of their contents. The eggs whose dimensions indicated that they were approaching the moment of deposition were but few; and their vitellus presented here and there the same phenomenon of fatty degeneration that was observed in the rest of the tubes, although the deposition of the membrane of the ovum by the epithelium had not ceased.

The second queen observed by M. Claus had not always produced sterile eggs. Her owner, who had obtained her the preceding summer, had ascertained that she laid fertile eggs. Even in the spring he still obtained results from them, but subsequently he ascertained that her fertility had ceased. M. Claus found the reproductive apparatus normal in all its parts, and the seminal receptacle was full of active spermatozoids. The interior of the ovarian tubes presented the same conditions as in the preceding queen, but in a still more distinct fashion. The ova contained in the lower dilatations of the tubes had the vitellus shrivelled into a solid, caseous mass, although the epithelium seemed to have retained its faculty of secreting the shell.

Lastly, M. von Siebold, having received from a Bohemian bee-keeper a queen which only laid sterile eggs, also ascertained that the organs had their ordinary structure, and that the receptacle swarmed with spermatozoids, but that the contents of the ovarian tubes presented an abnormal appearance. Both in the compartment containing vitellus and in the ova themselves, every thing indicated the existence of substances in decomposition. The eggs already enclosed in their shell and ready to be laid were in a very altered state, denoting a dissociation of the elements.

It is therefore an irregularity in the formation of the ovum, and especially of its vitellus, that causes this sterility. It is simply the result of a pathological state, and has nothing to do with parthenogenetic reproduction.

As regards the cause of this degeneration, M. Claus thinks that we must seek it in the influence of bad weather, and in insufficient nourishment. M. von Siebold admits that these circumstances may have a certain injurious effect; but, according to him, they are not the sole determining causes, since otherwise, as they are of frequent occurrence, queens with sterile eggs would not be so rare as they are in those countries.—*Zeitschr. für wissenschaft. Zoologie*, vol. xxiii., May 1873, pp. 198–210; *Bibl. Univ.* July 15, 1873, *Bull. Sci.* pp. 241–243.

Note on the Habitat of Psetalia globulosa *and* Labaria hemisphærica, *Gray.* By Dr. A. B. Meyer.

Dr. J. E. Gray described, in the 'Ann. & Mag. Nat. Hist.' xi. p. 234, 1873, the two new above-named free sponges sent home by me from Singapore. Dr. Gray observes that he believes these sponges were obtained in the neighbourhood of Singapore; and Mr.

H. J. Carter, in his paper, "Description of *Lubaria hemisphærica*, Gray, a new Species of Hexactinellid Sponge, with Observations on it and the Sarcohexactinellid Sponges generally," Ann. & Mag. Nat. Hist. xi. p. 278, says "Loc. unknown, from Singapore."

I beg to state that I obtained these sponges (as noticed in my letter to Dr. Gray from Singapore) from the reefs in the sea near the village Talisay, on the island of Cebu, Philippine Islands, in March 1872, on the same spot as the other new sponges obtained by me there and described by Dr. Gray in 'Annals,' x. p. 110, 1872, viz. *Meyerina claviformis*, *Crateromorpha Meyeri*, and *Rossella philippinensis*.

The sponges from these reefs, in the straits between the island of Cebu, some small islets near it, and the island of Bohol, are best to be got in the months March till August (the most favourable month is May) at full moon, when the current in the straits is very strong. The fishers drive with the current and draw behind them in their little boats long lines with small hooks constructed for the purpose. Therefore a little hole can be seen in nearly all specimens of *Euplectella aspergillum* and others, where the hook has destroyed the substance of the sponge. Some species are only found in great depths, 50 fathoms for instance; and only a few fishermen are skilful enough for sponge-fishing.

11 Wallfischgasse, Vienna,
Nov. 14, 1873.

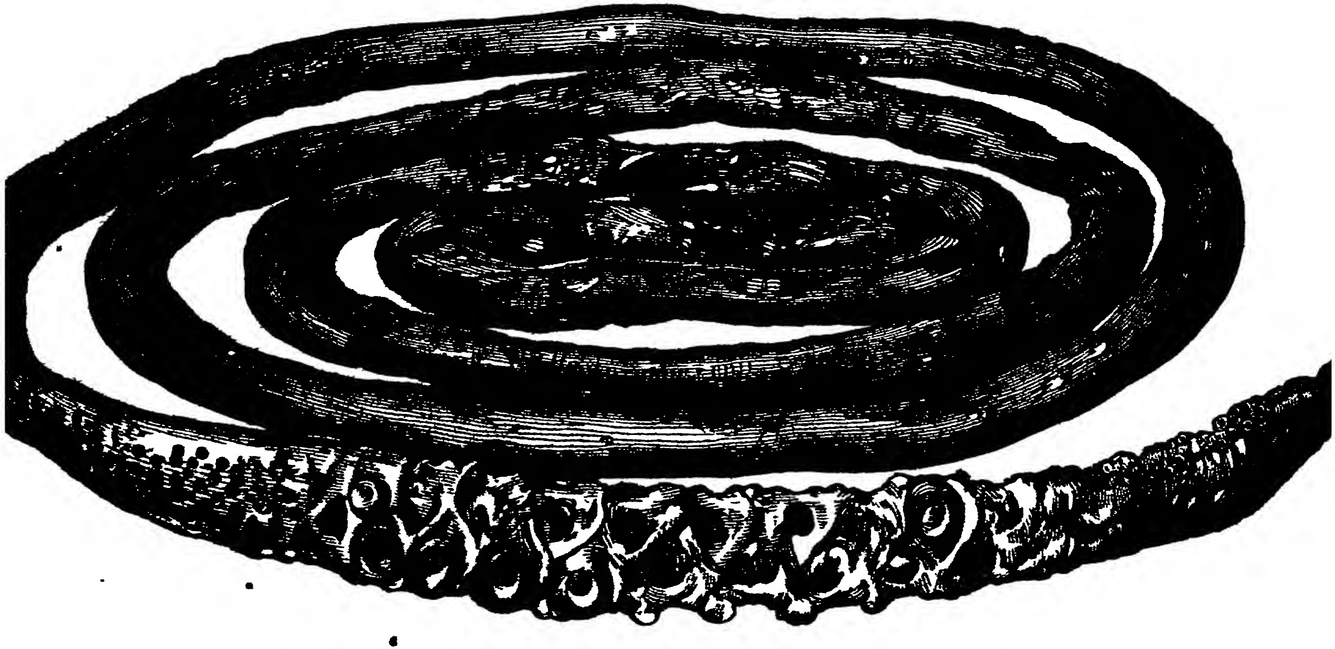
Gigantic Cuttlefishes in Newfoundland.

As the question of the existence of Cephalopoda of large size may still be regarded as to a certain extent open to doubt, the following letter from the Rev. M. Harvey of St. John's, Newfoundland, to Principal Dawson possesses considerable interest.

St. John's, Newfoundland,
Nov. 12, 1873.

My dear Doctor,—I take the liberty of bringing under your notice some account of a gigantic cuttlefish which was seen a few days ago in Conception Bay. The circumstances under which it was seen were as follows:—Two fishermen were out in a small punt, on October 26, off Portugal Cove, Conception Bay, about 9 miles from St. John's. Observing some object floating on the water at a short distance, they rowed towards it, supposing it to be a large sail or the *débris* of a wreck. On reaching it, one of the men struck it with his "gaff," when immediately it showed signs of life, reared a parrot-like beak, which they declare was "as big as a six-gallon keg," with which it struck the bottom of the boat violently. It then shot out from about its head two huge livid arms and began to twine them round the boat. One of the men seized a small axe and severed both arms as they lay over the gunwale of the boat, whereupon the fish moved off and ejected an immense quantity of inky fluid, which darkened the water for two or three hundred yards. The men saw it for a short time afterwards, and observed its tail

Tentacle of a gigantic Cephalopod from Newfoundland. (About one fourth natural size.)



in the air, which they declare was 10 feet across. They estimate the body to have been 60 feet in length, 5 feet in diameter, of the same shape and colour as the common squid; and they observed that it moved in the same way as the squid, both backwards and forwards.

One of the arms which they brought ashore was unfortunately destroyed, as they were ignorant of its importance; but the clergyman of the village assures me it was 10 inches in diameter and 6 feet in length. The other arm was brought to St. John's, but not before 6 feet of it were destroyed. Fortunately I heard of it, and took measures to have it preserved. Mr. Murray (of the Geological Survey) and I afterwards examined it carefully, had it photographed, and immersed in alcohol; it is now in our Museum. It measured 19 feet, is of a pale pink colour, entirely cartilaginous, tough and pliant as leather, and very strong. It is but 3½ inches in circumference, except towards the extremity, where it broadens like an oar to 6 inches in circumference, and then tapers to a pretty fine point. The under surface of the extremity is covered with suckers to the very point. At the extreme end there is a cluster of small suckers, with fine sharp teeth round their edges, and having a membrane stretched across each. Of these there are about seventy. Then come two rows of very large suckers, the movable disk of each 1¼ inch in diameter, the cartilaginous ring not being denticulated. These are twenty-four in number. After these there is another group of suckers, with denticulated edges (similar to the first), and about fifty in number. Along the under surface about forty more small suckers are distributed at intervals, making in all about 180 suckers on the arm.

The men estimate that they left about 10 feet of the arm attached to the body of the fish, so that its original length must have been 35 feet.

A clergyman here assures me that when he resided at Lamaline, on the southern coast, in the winter of 1870, the bodies of two cuttles were cast ashore, measuring 40 and 45 feet respectively.

More than once we have had accounts of gigantic cuttles cast ashore in different localities; but not until now have any portions of them been preserved.

By this mail I send you a photograph of the arm, it is one fourth the original in size. You will readily see the suckers at the extremity of the arm. The disks of several of the larger ones have been torn off by carelessness on the part of the captors; a few of them, however, are perfect; and the smaller ones are not injured. I shall send you also, by this mail, three or four of these suckers which I cut off, the smallest being from the very tip of the extremity and not much larger than a pin's head.

I shall be glad to hear your opinion of this fish at your earliest convenience.

It is a great pity one arm was destroyed; and it is still more to be regretted that we did not get the head of the monster.

Yours very sincerely,
M. Harvey.

The 'Field' of the 13th of December contains a notice of the occurrence described by Mr. Harvey, communicated by Mr. T. G. B. Lloyd, who received his information from Mr. A. Murray, Provincial Geological Surveyor of Newfoundland. Mr. Lloyd very justly suggests that the statement of the width of the animal is more likely to be approximately correct than that of its length, which seems to be excessive; and he is probably right in assuming that the length of the body of the animal was about 25 feet. The photograph sent by Mr. Murray represents one of the long tentacles of a decapod Cephalopod, probably a Calamary. A woodcut taken from it is given by Mr. Lloyd; and by the kindness of the Editor of the 'Field' we are enabled to reproduce this figure.

New Species of Shells. By F. P. Marrat.

Nassa elongata, Marrat.

N. testa elongato-conica, fulva, fascia pallida cincta, longitudinaliter costata transversimque sulcata; anfractibus sulcis æquidistantibus, ultimo basi rugoso; sutura tuberculis moniliformibus ornata; apertura ovata; columella plicata; labio callo tenui expanso tecto, labro margine serrato, intus lirato.

Hab. China seas.

Nassa lirata, Marrat.

N. testa ovata, fusca, fascia transversa albida cincta, longitudinaliter subcostata; costis superne nodosis, transversim striata; anfractu ultimo transversim sulcato; epidermide pallide fusca tecta; apertura parviuscula; labio cum callo circumscripto tecto, basi granuloso; canale subrecurvo; labro extus incrassato, intus valde lirato.

Hab. Philippines.

This shell has been long known in London among the dealers; and they all consider it to be new.

Nassa lucida, Marrat.

N. testa ovato-conica, albida, polita, longitudinaliter valde plicata, plicis subdistantibus; apertura ovata; columella lævi, infra fere biplicata; labro extus incrassato, intus dentato-lirato.

Hab. Keelings Island.

This is the most Scalaria-like species in the whole genus, the ribs being thick, white, and highly polished.

The following species of *Nassa* may stand thus:—

Nassa Kraussiana, Dkr.

N. orbiculata, A. Ad.

Nassa lurida, Gould.

N. dispar, A. Ad.

Nassa exilis, Powis.

N. panamensis, C. B. Ad.

Nassa complanata, Powis.

N. gemma, Phil.
N. cellaria, Brit. Mus. A small variety.

Nassa concentrica, Marrat.

N. concinna, Reeve, sp. 82; not the *concinna*, Powis, Reeve, sp. 91.

Nassa gaudiosa, Hinds, is not the shell figured in Reeve under that name.

Nassa Bronni, Phil., is a variety, with the outer lip muricated, of *N. coronata*, Lam.

100 Edge Lane, Liverpool.

The Number of Classes of Vertebrates, and their Mutual Relations.
By Prof. THEODORE GILL.

The mind, untrained in scientific logic, in its generalizations respecting the animal kingdom, if we may judge by the vague ideas elicited by inquiry and by the history of science, instinctively associates its subjects into groups determined by the nature of their habitat; and hence we have had the vertebrates differentiated into (1) those especially adapted for progression on land (Quadrupeds), (2) those especially fitted for progression through the air (Birds), and (3) those adapted for life in the water (Fishes); while the residue, not readily combinable with either of those classes, are tacitly overlooked, or, as the serpents, annexed as a kind of appendix to the Quadrupeds, because they most resemble certain of those animals—the lizards. It was therefore a great advance when Linnæus established a peculiar class (Mammalia) for the typical viviparous quadrupeds and the whales, and thus for the first time subordinated habitat and adaptation therefor to structure. While at the present day the ancient ideas have almost entirely disappeared from the system of nature so far as regards the terrestrial vertebrates, they are still to a great extent prevalent in the appreciation of the relations of the aquatic ones. For those vertebrates confounded by most naturalists under the name of Fishes are very dissimilar among themselves, and so much so even that the differences are more marked and radical than those between any of the superior classes of the branch. If, indeed, considerations of differences of structure are to guide us in the appreciation of the relations and subordination of animals, the current classification must be entirely changed, and the subordination of the highest groups, first suggested by Häckel, should be adopted with some modifications, while, as respects the combination of the "higher" or more specialized classes into superior groups, other principles should guide. One of the chief points to be reconsidered is the association of the Batrachians with Fishes rather than with the true reptiles. Although no

distinction may be possible between the first two when the class of Fishes has the wide range generally allowed, there is no difficulty in their discrimination with the limits here to be assigned to them. We may then group the classes as follows:—

On the one hand is *Branchiostoma* or *Amphioxus*, distinguished by the extension of the notochord (which is, of course, persistent) to the anterior end of the vertebral column, the attenuation of the spinal cord forward and its simple structure, the absence of auditory organs, the simple tubular structure of the heart, and the development of the liver simply as a diverticulum of the intestine.—This type is called by Häckel the subphylum *Leptocardia* or *Acrania*.

On the other hand are all the other vertebrates, which agree in the termination of the notochord behind the pituitary fossa, the enlargement of the spinal cord forward into a brain, the development of auditory organs, the division of the heart into (two to four) chambers, which in part (one or two) specially receive the blood, and in part (one or two) specially distribute it to the body again, and the differentiation of the liver as an independent and highly specialized organ.—This group is named by Häckel the subphylum *Pachycardia* or *Craniota*.

The numerous forms belonging to the last "subphylum" are also divisible into two great groups.

In one the skull has no cincture girdling the mouth, and consequently no lower jaw, there are no pectoral members or scapular girdle, and there is but one nasal sac, which has a median external aperture.—To this section belong the lampreys and hags, the representatives of the class of *Marsipobranchs*.

In the other, the skull has a cincture surrounding the mouth, its inferior portion being specialized as a lower jaw; they have (archetypically at least) a pectoral member and a shoulder-girdle developed; and there are two nasal sacs, each having an olfactory nerve distributed to an external aperture.—These vertebrates are again divisible into three groups or superclasses.

1. In the first (*Lyrifera*) the shoulder-girdle forms a lyriform or furcula-shaped apparatus, the scapulæ and their adjuncts of both sides being connected together below along the median line, and an air-bladder (sometimes lung-like) is typically developed (sometimes, however, atrophied) and (1) either connects with the œsophagus by a single duct or (2) is entirely closed. To this superclass belong the classes of Fishes and Elasmobranchiates.

2. In the second (*Quadratifera*) the shoulder-girdle is represented by the scapulæ and their appendages, which are limited to the respective sides, a sternum is differentiated, and instead of an air-bladder are two lungs, each with a special canal, which communicate with the pharynx. The lower jaw is compound and is articulated with the skull by the intervention of a special bone—the os quadratum. To this superclass belong the Batrachians, the Reptiles, and the Birds, the last two forming the group *Sauropsida*.

3. In the third (*Malleifera*) the shoulder-girdle is represented by composite scapulæ, limited to the sides or back; a sternum is

developed; respiration is entirely effected by highly specialized lungs communicating with a common trachea; and the lower jaw is composed of simple rami, and articulated directly with the skull, the os quadratum of the other vertebrates being converted into one of the auditory ossicles (the malleus). This superclass is represented by a single class—the Mammals.

The more these groups are studied in all their relations, the more natural do they appear.

As to other questions—that is, whether the true Fishes and Selachians are not separate classes, there is much to be said on both sides, and perhaps the arguments in favour of the class value of the Selachians may be even more weighty than those against them. If, indeed, the Birds and Reptiles are differentiated as distinct classes, similar rank can scarcely be consistently withheld from the Fishes and Elasmobranchiates. If I have heretofore hesitated, it is because of Dr. Gunther's very adverse views.

Without prejudice to the reconsideration of the question as to the systematic value of the group of Selachians or Elasmobranchiates, the classes of vertebrates may then be distributed, in a descending series, as follows:—

Branch VERTEBRATA.
- A. Subbranch CRANIOTA.
  - Superclass MALLEIFERA.
    - I. Class Mammalia.
  - Superclass QUADRATIFERA.
    - (Sauropsida.)
    - II. Class Aves.
    - III. Class Reptilia.
    - (Batrachopsida.)
    - IV. Class Batrachia.
  - Superclass LYRIFERA.
    - V. Class Pisces.
    - VI. Class Elasmobranchiata.
  - Superclass MONORRHINA.
    - VII. Class Marsipobranchia.
- B. Subbranch ACRANIA.
  - VIII. Class Leptocardia.

The most nearly related pair of classes are those of Birds and Reptiles; and preeminently the most homogeneous is that of Birds, all the living representatives of which seem to be members of a single order (which may be distinguished by the name Eurhipidura), and at most divisible into two suborders, the Carinatæ and the Ratitæ. Other orders are represented by extinct types, viz. Saururæ and (if the vertebræ are peculiar to the group) Odontornithes.—*Abstract of a communication to the National Academy of Sciences, made* Oct. 29, 1873. *Communicated by the Author.*

The Parasitic Mites of Birds, a Contribution to the Knowledge of the Sarcoptidæ. By E. Ehlers.

The observations of M. Ehlers, which relate to interesting questions of adaptation and heredity, are made upon an Acarian very nearly allied to that described by M. C. Robin under the name of *Sarcoptes mutans*. It is also a bird-parasite, and was discovered on a specimen of *Munia maja*, in which it produced excrescences at the base of the beak. For this species and M. Robin's the author establishes the genus *Dermatoryctes*, which is particularly characterized by the form of the feet in the two sexes. He calls his species *Dermatoryctes fossor*.

The female of *D. fossor* is much larger than the male, and also very different in form. It is incapable of moving outside the galleries which it inhabits, partly because it is encumbered by the large eggs which it carries in its body, and partly because it cannot touch the ground with its feet. These (which are extremely short) present an epimeron, a coxa, and leg formed of three joints, the terminal joint being a sort of quadridentate clasper, probably homologous with the two joints which are distinct in *D. mutans*, and which M. Robin calls tibia and tarsus.

The males are smaller and much more active, and also less numerous, than the females. Their body is contracted in front and behind; their legs are much longer than those of the females, and differently constructed; in particular, they bear long hairs, and each of them has a sucker with a long pedicle on its terminal joint.

M. Ehlers was unable to ascertain whether this Acarian is oviparous or viviparous. He supposes that the membrane of the egg becomes much attenuated at the close of the development, and that the embryo is born after having got free from it, or that this membrane is ruptured during the birth.

In the first period of their life the young Acarians run easily by means of their three pairs of legs, which are long and very like those of the adult males; each of them bears at its extremity a sucker with a long pedicle, and five hairs, the longest of which exceeds the sucker.

The transformations through which the animal afterwards passes are the results of a certain number of moults, which must be regarded as being more than mere changes of skin. During these moults the mite remains in a state of immobility and rigidity, which seems to indicate that we have to do with a true case of nymphosis, accompanied by new formations analogous to those observed by Weissman in the metamorphoses of insects. Küchenmeister had previously witnessed phenomena of this kind in *Sarcoptes scabiei*, and Claparède has described in detail the manner in which a new development takes place in the interior of the old skin in *Atax* and *Hoplophora*. Matters appear to go on in an analogous fashion in the species observed by M. Ehlers, although this naturalist was unable to ascertain positively that complete histolysis takes place.

There are remarkable differences between the development of the male and of the female. The male undergoes no profound changes in passing from the larval to the adult state. In those two phases of its existence it presents the same peculiarities of structure. Its structure perfectly resembles that which we observe in the Sarcoptidæ in general, in which the legs bear long hairs, and some of them, if not all, have also pedunculated suckers. The characteristics of the family which exist in the young persist in the male until the adult state.

In the females it is otherwise. The changes which take place in the course of development give rise not only to differences which characterize the adult, but also to arrangements which are not met with in other Sarcoptidæ.

At the last moult but one the female appears with its eight legs, its genital aperture, and all its other principal characters. It is then only distinguished from the adult by its not yet having ova in its body, and by the dorsal shield only presenting pointed, conical protuberances, instead of the flattened scales which this region exhibits in the adult. After increasing in bulk it undergoes another moult in order to attain its definitive condition, in which the dorsal surface is covered with flattened scales. These protuberances, which are in themselves of but little importance, are interesting because they also appear in the mites of the genus *Sarcoptes*, in which they are particularly developed in the female sex. In the species of which the adult females do not present these projections, they are also wanting in the male; in *Sarcoptes scabiei* they are found not only in the adult female, but also, although much less developed, in the male. In *Dermatoryctes fossor* they are exclusively characteristic of the female. M. Ehlers thinks that this formation of the skin may have been originally a secondary sexual character of the females which has become a little attenuated in the species under consideration, whilst in other female Sarcoptidæ it has maintained itself and even been transmitted to the males by heredity.

The legs of the females undergo remarkable transformations at the last moult; they become short stumps which have lost a joint, and no longer possess hairs or suckers. The Sarcoptidæ of the Mammalia present a similar modification, although far less profound; for the females have their last two pairs of legs destitute of suckers, whilst the males possess them at least on the last pair but one. On the other hand, in *Dermatophagus* and *Dermatokoptes* (Fürst.) the female has a sucker at least in one of the posterior pairs of feet, and in the male we find one on each foot; this fact is the more remarkable because in these genera the sucker does not exist in the larval state, and only appears at the last change of skin. The two genera in question differ from the true *Sarcoptes* in not piercing canals in the epidermis of their host, but living more on the surface, concealed by the hairs, the cells detached from the epidermis, &c. The disappearance of the suckers and the shortening of the legs consequently seems, in the *Sarcoptes*, to be in connexion with the mode of life, and especially with the nature of the habitat; so that those which

require to form galleries undergo the greatest abbreviation of the legs, which must have been influenced especially by the comparative disuse of those organs.

The female of *D. fossor* lives at the extremity of a straight gallery, which it completely fills. Under such conditions its short, strong legs are very useful to it in progressing after the fashion of a mole, by pressing obliquely against the walls of the gallery, so as to push the animal forward. Outside the gallery these legs could be of no use to it. The young females and the males, on the contrary, can move in galleries which are as it were too large for them.

The rectilinear direction and the small size of the galleries is explained by the hardness of the horny substance of the beak in which they are pierced, which causes the animals to confine themselves to a straight passage, having exactly the calibre of their bodies. In the Mammalia, the epidermis of which forms a less resistant tissue, the passages are tortuous, increase gradually in depth, and offer more space to the mites than is afforded to the parasite of the bird's beak. —*Zeitschr. fur wissenschaftl. Zoologie*, vol. xxiii. pp. 228–253; *Bibl. Univ.* July 15, 1873, *Bull. Sci.* pp. 244–247.

Contributions to the Knowledge of the Laboulbeniæ. By Dr. J. Peyritsch.

The author describes the mode of occurrence and the development of these parasitic fungi. Hitherto only five species of *Laboulbeniæ* were known, three of which were observed on beetles. New species have been detected on Carabidæ, Staphylinidæ, and Dytiscidæ. By their development, and especially the process of fecundation, the *Laboulbeniæ* approach the other Ascomycetes; fecundation takes place by the contact of delicate, filiform organs, pollinodia and trichogynæ. The pollinodia are developed at the terminal part of the young plant upon peculiar bearers, the form of which is characteristic of the species; the trichogyne terminates the rudiment of the fruit. In some species the latter is a delicate filament of several joints; but in *Laboulbenia muscœ* it is unicellular; in all species it is thrown off after fecundation. The fruit is only developed after fecundation; it opens by an apical pore and allows the spores to escape. The spores are produced in diverticula of one (or several?) cell in a series of cells, the upper extremity of which previously formed the trichogyne. The form and insertion of the bearer of the pollinodia and its appendicular structures, and the form of the armature of the mouth of the fruit, furnish the most important characters for distinguishing the species of this small group of fungi. Dr. Peyritsch's memoir contains descriptions of all the species, which are referred to five genera.—*Anzeiger der Akad. der Wiss. in Wien*, October 23, 1873.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 74. FEBRUARY 1874.

XII.—*Descriptions of two new Genera and Species of Polyzoa from the Devonian Rocks.* By H. ALLEYNE NICHOLSON, M.D., D.Sc., M.A., F.R.S.E., Professor of Natural History in University College, Toronto.

In the following communication I propose to describe two new genera of Polyzoa which I have been compelled to found for the reception of two remarkable fossils from the Devonian rocks of Western Ontario. Both of these belong to the family of the Fenestellidæ; but they differ in an extraordinary manner from all previously recorded genera, and present certain points of structure of a very anomalous nature.

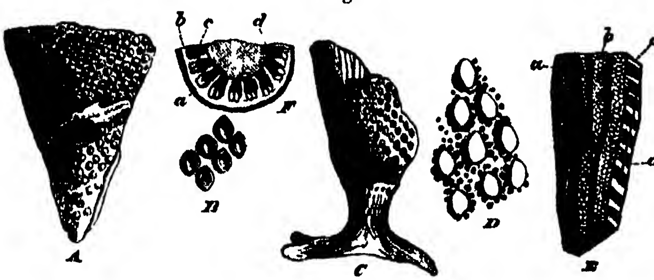
Genus CRYPTOPORA (Nicholson).

Polyzoary forming a rigid, infundibuliform, calcareous expansion, springing from a strong solid branching root-stalk or rhizome. Exterior of the cœnœcium forming a continuous non-perforated calcareous layer, internal to which is a second or intermediate layer, the two being composed of the amalgamated and coalescent branches ("interstices"). The intermediate layer is marked by shallow and bifurcating longitudinal sulci, corresponding with the lines between the branches; and its surface exhibits reticulating lines which correspond with the bases or proximal ends of the cells beneath; but no fenestrules are present. The internal surface of the intermediate layer carries the cells, which are flask-shaped, and

are arranged in double alternating rows forming regularly flexuous lines enclosing oval interspaces, exactly as in *Retepora*. The oval interspaces, however, instead of constituting so many "fenestrules," are the bases of so many pillars, which proceed perpendicularly inwards, across a central space, to join with an internal calcareous membrane which forms the innermost lining of the funnel-shaped frond.

It follows from the above description that the mouths of the cells in *Cryptopora* neither open on the exterior of the frond, as is commonly the case in *Fenestella*, nor upon the interior of the frond, as is the case in the infundibuliform species of *Retepora*. On the contrary, we have in this extraordinary genus the unique arrangement that both the internal

Fig. 1.



Cryptopora mirabilis, Nich.: A, a partially decorticated specimen, natural size; B, a small portion of the same, showing the inner ends of the perpendicular columns, enlarged; C, another partially decorticated specimen, springing from a strong footstalk, natural size; D, part of the internal surface of the intermediate layer, showing the mouths of the cells and the broken perpendicular columns, enlarged; E, a small portion of the frond, enlarged and somewhat diagrammatically represented; F, transverse section of part of the frond, enlarged and also slightly diagrammatized (*a*, the external smooth membrane; *b*, the intermediate sulcated layer; *c*, the central space containing the cells and traversed by the perpendicular columns; *d*, the internal membrane).

and the external aspects of the funnel-shaped polyzoary are to all appearance closed by a continuous calcareous membrane. The cells are not placed upon either of the free surfaces of the polyzoary, but occupy a central space, which has its internal wall formed by the innermost membrane, and its external wall by an intermediate layer composed of the laterally coalescent branches. The cells are situated upon the internal face of the outer wall of this central space; and the two walls are kept apart by a system of pillars, which traverse the central space perpendicularly, and correspond in position with the fenestrules

of a *Retepora.* It would thus appear that the water must have been admitted to this central space, and thus to the cells, by openings in the free edge or lip of the infundibuliform polyzoary; but none of my specimens exhibits this portion of the frond.

In the genus *Hemitrypa*, Phillips, the fenestrules do not perforate the cœnœcium so as to reach the outer face of the frond, but are filled by a calcareous membrane. The cells, however, open upon the external surface, instead of into a central space; and the structure of the polyzoary is in other respects very different.

The following is the only species of the genus that I have as yet met with, though additional forms will probably be afterwards detected.

Cryptopora mirabilis (Nicholson).

Polyzoary infundibuliform, apparently from one to three inches in height and three quarters of an inch or more in diameter distally. External layer thin, imperforate, smooth or obscurely striated. Intermediate layer formed of the coalescent branches, and marked externally by vertical shallow grooves, which are placed about half a line apart and sometimes bifurcate. Between these grooves the external surface is mapped out by inosculating lines into small oval or polygonal spaces corresponding with the cells. The internal surface of the intermediate layer carries the cells, which are arranged biserially in flexuous lines, and enclose oval or rhomboidal interspaces. These interspaces are arranged in very regular diagonal lines, about four in the space of two lines; and they give origin to a series of short rounded pillars, which extend inwards at right angles to meet the internal layer. The central space, in which the cells are situated, is about half a line to two thirds of a line in depth. The internal layer is apparently thin and membranous. The entire frond springs from an exceedingly strong, horizontal, branched stalk, the surface of which is marked by vermicular striæ.

The materials in my hands are not sufficient to permit of an entirely satisfactory elucidation of the characters and structure of this remarkable species. Different specimens, however, or different parts of the same specimen, show the following appearances:—

1. The external membrane is thin, and is only preserved in parts of any specimen that I have seen; and as it corresponds with the reverse or non-poriferous face of an ordinary *Retepora*, it is to be regarded in reality as nothing more than the exterior portion of the intermediate layer.

2. The intermediate layer (together with the external layer, as just remarked) is clearly formed by the coalescent branches. When viewed from the outside, where the thin outer layer has been stripped off, it exhibits shallow vertical grooves, marking out the original branches, and it also shows in outline the proximal ends of the cells below (fig. 1, E, *b*).

3. Specimens which exhibit the hollow interior of the funnel, from which the innermost membrane has been removed in whole or in part (fig. 1, D), exhibit the mouths of the cells as rounded pores placed on the inner aspect of the amalgamated branches. The cells are arranged in double alternating rows forming regularly bent or undulated lines, each of which corresponds with the inner surface of a branch, and which, by their inosculation, enclose oval spaces corresponding to fenestrules, but occupied by short solid columns.

4. Specimens which are broken across transversely (fig. 1, F) show that, instead of fenestrules or perforations between the anastomosing branches, we have a series of stout pillars, which run perpendicularly inwards from the poriferous face, and have their internal ends connected together by a thin calcareous membrane, which forms the innermost lining of the funnel-shaped frond. There is thus formed a central space (*c*), which is lined outwardly by the cells, and to which water can apparently not have been admitted otherwise than by openings in the margin of the funnel.

5. Specimens which are *casts* of the interior of the frond, to which the innermost membrane with the ends of the perpendicular columns still remain adherent, are not uncommon (fig. 1, A & C). These show that the columns are so arranged as to form beautifully regular diagonal lines; and their inner ends seem to have been convex, as they in many cases leave concave or cupped scars of an oval or rhomboidal shape upon the outside of the cast (fig. 1, B).

6. One specimen exhibits a strong horizontal footstalk, from which the cœnœcium grew up vertically (fig. 1, C). This footstalk is branched at both ends; its surface is covered in parts with vermiculated striæ; and its structure seems to have been minutely tubular or cellular.

7. Lastly, some specimens show the extraordinary character of a second frond, quite similar in structure to the first, invaginated within the outer one, so as to give rise to an internal cone closely applied to the external funnel. I am at present, with the comparatively imperfect materials in my possession, unable to offer any explanation of this remarkable feature.

Locality and Formation.—Not uncommon, though always more or less imperfect, in the Corniferous Limestone (Devonian), Port Colborne and Lot 6, Con. 1, Wainfleet.

Genus CARINOPORA (Nicholson).

Polyzoary infundibuliform, calcareous, and reticulated. The external layer of the cyathiform frond is composed of regularly undulated flexuous branches ("interstices"), which anastomose with one another, after the manner of a *Retepora*, so as to form a series of oval fenestrules. Exteriorly the branches are angulated or carinate, and are smooth and non-celluliferous. Internally each branch gives origin to an enormously developed keel or vertical lamina, which corresponds in direction with the branch, and is directed inwards towards the centre of the funnel. The inner surface of the branches thus presents a series of parallel ridges of great height, separated by deep grooves, at the bottom of which, to all appearance, the cells open. The fenestrules also open at the bottom of these grooves. In parts of the frond, however,

Fig. 2.

Illustrations of the structure of *Carinopora Hindei*, Nich.: *a*, fragment of the exterior, natural size; *b*, portion of the same, enlarged; *c*, another portion of the exterior, still further enlarged; *d*, a fragment from which the external non-celluliferous layer has been removed, showing the cells, enlarged; *e*, a fragment more deeply decorticated, showing the mouths of the cells, enlarged; *f* & *g*, transverse sections of the frond in different parts, enlarged; *h*, a portion of the internal surface, enlarged; *i*, transverse section of a single branch, enlarged.

these grooves are apparently rendered vesicular by the development of a series of delicate calcareous laminæ, which connect together the sides of contiguous ridges. In some cases, also, the inner edges of the ridges are connected together by a continuous calcareous membrane, so that the inner surface of the frond is completely closed. The cells are carried in alternating double rows upon the inner and lateral aspects of each branch, their mouths appearing to be situated at the bottom of the grooves before mentioned and at the base of the great keel which springs from each branch internally. Obviously, how-

ever, the row of cells on one side of any branch opens into one groove, whilst the row on the opposite side of the same branch opens into a contiguous groove, and not into the same one. No cells are carried upon the areas formed by the anastomosis of contiguous branches.

I have only seen a single, very large and well-preserved example of this genus; and a careful examination of this has still left me unable to elucidate and explain some of the most extraordinary structural peculiarities which it presents. There can, however, be no doubt as to the complete distinctness of the genus from any previously described. A comprehension of the very remarkable characters presented by this genus will perhaps be best obtained from a detailed account of the different figures of the above illustration, all of which represent different portions of the only known specimen:—

a. This figure exhibits a portion of the exterior of the frond, showing the fenestrules and the outer non-celluliferous aspect of the branches. In the portion here illustrated of the natural size, and partially shown at *b* on an enlarged scale, the fenestrules are oval and arranged in diagonal lines, and the branches are strongly keeled—the general appearance closely resembling the non-celluliferous aspect of *Retepora prisca*, Goldfuss, and the fenestrules being similarly formed by the simple inosculation of the branches without the development of distinct dissepiments.

c. This represents another portion of the exterior of the frond, nearer to the base, where the fenestrules are polygonal or hexagonal and are not arranged in regular diagonal lines. Here also every fourth or fifth branch has a nearly straight direction, giving the network quite a peculiar appearance. In some cases, lastly, the fenestrules present the appearance of being closed by a delicate external membrane.

d. This shows a small portion from which the outer non-celluliferous layer has been denuded, showing the proximal ends or bases of the cells, arranged in a double inosculating row on each branch, and lying in the same plane as the fenestrules.

e. This figure exhibits, on an enlarged scale, a small portion of the exterior of the frond, from which the outer non-celluliferous layer has been stripped off together with the cells themselves, leaving to view the circular mouths of the cells arranged in two alternating rows, which are still on the same plane as the fenestrules, and which do not encroach upon the spaces formed by the inosculation of the branches.

f. This figure is a greatly magnified representation of a transverse section of the frond at a point considerably removed

from the base, showing the branches cut across. Above, the branches are separated by the fenestrules; and immediately beneath this are seen the dark oval spaces which represent the cavities of the biserial cells, and two of which are contained within the cavity of each branch. Below this, again, each branch is seen to give off an immense keel or ridge, which is directed inwards towards the interior of the frond. These ridges are separated by deep intervening grooves; and there can be no doubt that the cells open at the bottom of these grooves, those of one side of the branch opening on one side of the base of the great keel, and those of the other opening upon the opposite side of the same.

g. This exhibits a greatly magnified transverse section of the frond at a point a little above the base. As in the preceding, we can recognize without difficulty the shallow fenestrules, the divided branches carrying in their interior each a pair of cells, and the great internal keels. Here, however, we have two new features: first, the deep grooves between the keels are subdivided by delicate calcareous laminæ, which connect the opposite sides of contiguous keels, and divide the intervening grooves into shallow transverse chambers; secondly, the grooves between the keels are closed internally by a continuous calcareous membrane which has a minutely porous or vesicular structure.

h. This represents a fragment taken from near the base of the funnel and exhibiting the internal surface of the polyzoary. We see here the inner faces of the great longitudinal keels; but instead of these being separated by deep sulci as in the upper portion of the frond, they are here separated by shallow rounded grooves formed by a continuous calcareous membrane, which is not penetrated by either the fenestrules or the cells. No apertures, therefore, of any kind appear on the interior of the cœnœcium near the base, the open interstitial grooves of the upper portion of the frond being here closed by a continuous connecting layer. At the right-hand corner of the figure the keels and their connecting membrane are broken away, so that we see the cavities of the rows of cells; whilst the extreme corner is still further broken away, so that the fenestrules come into view.

i. This simply represents a single branch in transverse section, greatly enlarged, and shows the cells in the interior of the branch and the great triangular keel proceeding from its internal surface.

From the above description it will be evident that the structure of *Carinopora* is quite anomalous, and wholly unlike any thing that has hitherto been observed in any member of

the Fenestellidæ. The most anomalous point is the position of the cells, or rather their mode of opening on the surface. The cells open towards the interior of the funnel-shaped frond, as in *Retepora*, and in the upper portion they seem to open simply at the bottom of the deep intercarinal grooves, into which the fenestrules also open; so that there is here no special difficulty, if, as seems tolerably certain, the keels are not here connected by an imperforate membrane, and the grooves thus remain open to the access of sea-water. Near the base, however, the keels are clearly connected by a continuous imperforate membrane, and the deep intervening grooves are filled up by a vesicular calcareous tissue, so that the sea-water could not have gained access to the mouths of the cells. The only explanation that I can offer is that the basal portion of the polyzoary may perhaps have been gradually overgrown internally by this layer of vesicular tissue, and may thus have been practically killed, whilst the upper portion remained open to the sea and genuinely alive. If this was not the case, I cannot explain the undoubted facts.

The enormous internal keels, whether free or connected together by membrane, give an extraordinary depth and thickness to the polyzoary; and the fenestrules do not extend to more than about one fourth of this depth from the outside; nor do the cells. In *Hemitrypa*, Phill., the fenestrules do not extend through the entire thickness of the polyzoary; but in this genus the fenestrules are confined to the *inner* surface of the funnel-shaped frond, and the cells open *externally*. In *Cryptopora*, Nich., again, the outer and inner surfaces of the polyzoary are *both* imperforate, and the cells open into a central space, which is crossed by regularly placed pillars having a direction perpendicular to the plane of the frond.

The following is the only species of the genus *Carinopora* which has come under my notice.

Carinopora Hindei (Nicholson).

This being the only species of the genus, it is not needful to recapitulate its structural characters, since these, so far as known, have been fully discussed above. It only remains to give the measurements by which the species is distinguished, along with one or two characters which are not of generic value. The only known specimen exhibits a portion of a very large infundibuliform frond, which, though fragmentary, has a height of four inches, with a diameter at the top of clearly more than half a foot. The actual base is broken off. About six branches occupy the space of two lines. The fenestrules are sometimes oval, sometimes hexagonal or polygonal; and their

arrangement differs in different parts of the frond. Sometimes they are disposed in regular diagonal lines; but even in this case there are often perceptible central longitudinal lines, on either side of which the diagonal rows of fenestrules diverge in opposite directions like the barbs of a feather, giving rise to a most peculiar appearance. At other times the fenestrules are rhomboidal, or hexagonal, or polygonal, and are not arranged in distinct diagonal rows; whilst two contiguous longitudinal rows are often separated by an unusually narrow and apparently quite straight branch (see fig. 2, *c*). The spaces along which the flexuous branches inosculate have a depth of about half a line, considerably exceeding the width of the branches; so that whilst seven fenestrules occupy a quarter of an inch measured diagonally, only four occupy the same space measured longitudinally. The thickness of the frond, measured at right angles to its plane of growth, is one line or a little more, nearly two thirds of this being accounted for by the great internal keels. Lastly, there are generally three cell-mouths to the length of a fenestrule, with two placed opposite the inosculation of each pair of contiguous branches.

The only known example of this singular species was discovered by my friend Mr. George Jennings Hinde, by whom it was submitted to me for examination, and in whose honour I have named it.

Locality and Formation.—Corniferous Limestone, Jarvis, county of Walpole.

XIII.—*The Geographical Relations of the New-Zealand Fauna.* By Captain F. W. Hutton, C.M.Z.S.

[Concluded from p. 39.]

Fish.

Up to the present time about 134 species of marine fish are known to inhabit the shores of New Zealand. Of these, 51 (or 37 per cent.) are found nowhere else; 38 extend to the Australian and Tasmanian seas, but no further; six range to the Pacific islands, five inhabit South America, four South Africa, and one Kerguelen Land and the Auckland Islands; there are also four others that are common to both Australia and South America, five common to Australia and South Africa, two common to Australia and the Pacific islands, and one common to Australia and the Auckland Islands. Thus the total number of our sea-fishes found in Australia is fifty, in South America and the Cape of Good

Hope nine each, three (*Prosopodasys cottoides, Trygon Kuhlii,* and *Ostracion Fornasini*) are not found nearer than the Indian archipelago (the identification, however, of the latter is doubtful), and one (*Halargyreus Johnsoni*) has been obtained at Madeira only. The remaining thirteen are widely ranging species. These 134 species have been distributed among 114 different genera, eleven of which are not found elsewhere. The connexion with Australia is here, as might be expected, so well marked that I need not dwell upon it, but will proceed to examine the affinities of New Zealand to other countries. Our former connexion with South America is indicated by *Mendosoma lineata, Notothenia cornucola, Merluccius Gayi,* and *Genypterus blacodes*; with South Africa by *Trigla kumu, Gonorhynchus Greyi,* and *Bdellostoma cirrhatum*; while the occurrence of *Gonorhynchus Greyi* and *Congromuræna habenata* at St. Paul's shows that that little volcanic island was also probably connected. The occurrence in New Zealand of species belonging to the southern genera *Pseudorhombus, Bovichthys, Agriopus, Chilodactylus,* and *Scorpis* points to the extension of a former antarctic continent of which these islands formed a part; while *Acanthurus triostegus, Dascyllus aruanus, Chanos salmoneus, Peltorhamphus novæ-zealandiæ,* a species of sting-ray allied to *Trygon thalassia,* and species of the genera *Labricthys* and *Trachelochismus* show an affinity for the islands of the Pacific.

I have already remarked that three of our fishes are not found nearer than the Indian archipelago; and it is probable that our species of *Torpedo* and *Doryichthys* came from that direction also. But a still more curious affinity to Japan is shown by the presence of the genera *Lotella* and *Ditrema,* and of another little fish (*Calloptilum punctatum*) which is found at the mouth of the river Thames, and which has its nearest allies in the genus *Bregmaceros* from China and the Philippine Islands. *Gonorhynchus Greyi* and *Clupea sagax* are also both found in Japan, but they occur in Australia as well. Our species of *Ditrema* differs from *D. læve* of Japan in having teeth on its palate and a band of teeth in each jaw instead of a single row. *Platystethus cultratum,* from Norfolk Island, is also closely allied. This connexion with China and Japan is, I consider, the chief point of interest in the distribution of our marine fish.

In the genus *Tripterygium,* which is found only in the Mediterranean, we have an anomaly which is parallel to the cases of *Fuligula* and *Mergus* among the birds; and as we proceed we shall find many other similar cases cropping up.

The freshwater fish naturally supply more important evi-

dence as to the former distribution of land than those inhabiting the sea. Of these, New Zealand possesses fifteen species belonging to seven genera, of which six species, or 40 per cent., and one genus are found nowhere else. That the percentage of the endemic freshwater fish should be nearly the same as that of the marine fish is a remarkable and unexpected result; for the number of species of marine fish inhabiting New Zealand and found also in other countries depends partly on permanency of specific characters since New Zealand was isolated, and partly on the power possessed by fishes of migrating to us from other countries, while among the freshwater fish the proportion depends entirely on permanency of specific characters; consequently this permanency of specific characters must be greater in freshwater than in saltwater fish; and this is the more remarkable as our freshwater fish are far more variable, especially *Galaxias attenuatus* and *Eleotris gobioides*, than the marine; and *Galaxias attenuatus*, being found both in South America and in Tasmania, must have had a longer specific existence than any of the others. It is therefore evident that a great amount of variability is not inconsistent with great specific longevity under certain conditions. The conditions in this case are, I believe, the absence of any large rapacious fish preying on the smaller variable ones, and thus tending to fix those varieties which are best adapted to elude the observation of the enemy. These conditions will soon no longer exist in our rivers, on account of the introduction of the trout; and I should like to draw attention to the fact that descriptions and figures of all the varieties of fish occurring now in one or more of our rivers would be a most valuable contribution to science as material for future naturalists.

Of our freshwater fish found beyond New Zealand, *Retropinna Richardsoni* is found in the Chatham Islands, *Galaxias fasciatus* in both the Chatham and Auckland Islands, *Galaxias attenuatus* in the Chatham Islands, Tasmania, Patagonia, and South America, *Galaxias olidus* in Australia, *Anguilla aucklandii* in the Auckland Islands, *Anguilla australis* in the Auckland Islands, Tasmania, and Timor, *Anguilla latirostris* in the Chatham Islands, Europe, Egypt, China, and the West Indies, *Geotria australis* in Australia, and *Geotria chilensis* in Western Australia and Chile. Thus four of our freshwater fish are found in the Chatham Islands and three in the Auckland Islands, which are all the freshwater fish known to inhabit those places; three are found in Australia, two in Tasmania, two in South America, one in the island of Timor, and one is spread from China to Europe and the West Indies. The Aus-

tralian grayling also (*Prototroctes marœna*), although a distinct species, much resembles our own (*P. oxyrhynchus*); and another closely related genus (*Haplochiton*) is found in South America.

The genus *Eleotris* is widely spread in tropical countries. Its head quarters are in the Indian archipelago; and it ranges west to Madagascar, east to Mexico and the West Indies, north to Japan, and south to New Zealand, but is not found in Africa. The nearest ally of our species (*E. gobioides*) is *E. obscura* from Japan and China.

The evidence, therefore, to be derived from the freshwater fish goes to prove that a close connexion has existed between Australia, New Zealand, and South America. The fact of two species of the same genus of grayling being found in Australia and New Zealand respectively, while South America is inhabited by a closely allied but distinct genus, indicates either that our connexion with Australia was later than with South America, or that in the old continent New Zealand and Australia were inhabited by one, and South America by another species of the same family. The freshwater fish also prove that our connexion with the Chatham and Auckland Islands was much later than with Australia. The distribution of *Anguilla latirostris*, which is not found nearer than China*, adds its testimony to that of *Lotella* and *Ditrema* of a former connexion with that part of the world not by way of Australia; and we shall find that this remarkable connexion with China and the Indian archipelago thus dimly shadowed out by the fishes, gets stronger and stronger as we review the invertebrate animals.

MOLLUSCA.

Of the New-Zealand Mollusca about 460 species are now known, of which about one half are found nowhere else. They show, as might be expected, a marked affinity with Australia, but are still very distinct. We miss *Olivella*, *Vanikoro*, *Eutropia*, *Perna*, *Trigonia*, and others; while *Mitra*, *Columbella*, *Marginella*, *Natica*, *Scala*, *Conus*, *Cypræa*, and *Cardium* are very feebly represented with us. On the other hand, Australia does not possess *Buccinum*; and *Fusus*, *Imperator*, *Purpura*, *Turritella*, and *Pecten* are much less developed than in New Zealand. As, however, the affinity is decided, I shall here limit myself to pointing out our connexion with other countries.

Of Cephalopoda we possess eleven species, only two of which are peculiar to New Zealand. *Onychoteuthis Bartlingii*, *Ommastrephes Sloani*, *Nautilus pompilius*, and *Argonauta nodosa*

* Dr. Günther has lately described *A. obscura*, a closely allied species, from the Fiji Islands.

are all found in the Indian Ocean, and the last two in the Pacific also, but none of them in Australia.

Of marine Gasteropods and Conchifera, omitting the marine air-breathers, we have 330 species, about 160 of which are endemic. Of these, *Cyclina Kröyeri*, *Mytilus magellanicus*, and *Anomia alecto* are only found in South America, as also is the genus *Solenella*. *Chione mesodesma* is found at Valparaiso and the Philippine Islands, *Barbatia pusilla* in Peru and Australia, *Myodora ovata* in the Philippines and Australia, *Mytilus smaragdinus* and *Anomia cytæum* in China; while we also have a small *Cypræa*, which appears to me to differ from *C. punctata* (from the Philippines) only in the absence of red spots. *Bankivia varians* is found in South Africa and Tasmania. Our common pipi (*Chione Stutchburyi*) is found in Kerguelen Land; while *Ranella vexillum*, which is also found in Tasmania, is closely allied to *R. argus* from the Cape of Good Hope, and to *R. proditor* from St. Paul's Island. The genera *Phorus*, *Rotella*, and *Calyptræa* are found in the Philippine Islands and China, but not in Australia. The genus *Lyonsia*, of which we possess one species, extends from Europe and India to the Philippine Islands and Borneo, and is also found in Peru and the West Indies. A few of our shells are almost cosmopolitan, as *Lucina divaricata*, *Saxicava arctica*, *Crypta unguiformis*, and *Lima squamosa*; while *Nucula margaritacea* inhabits Europe, *Dosinia subrosea* is said to have been found in the Persian Gulf, and the genus *Solemya* is found only in Australia and the Mediterranean. While, therefore, our marine shells show a decided affinity to Australia, they also show a slight connexion with South Africa, Kerguelen Land, St. Paul's, and South America, and point more decidedly to a connexion with the Philippine Islands and China.

Of land and freshwater shells, including the marine air-breathers, we possess 114 species, of which 97 are not found elsewhere. These show many striking and important facts in distribution. Three only (*Helix subrugata*, *H. sydneyensis*, and *H. rapida*) are found in Australia; and of these the second is so like *H. cellaria* of Europe that it has only lately been distinguished from it by Dr. Cox, and is also closely allied to *H. glaberrima* from the Solomon Islands. *Helix rapida* is also found at Erromanga, one of the New Hebrides. *Helix coniformis** inhabits the Louisiade Islands, *H. radiaria* the

* I am indebted to His Honour T. B. Gillies for the information that *H. coniformis*, *H. radiaria*, *H. subrugata*, and *H. vitrea* inhabit New Zealand. Mr. Gillies collected the specimens in the northern portion of the province of Auckland; and they were determined by Prof. Macalister, of Trinity College, Dublin.

Solomon Islands, and *H. vitrea* the Admiralty Islands. *Cassidula mustelina* is found at Singapore and Pulo-Penang, and *Amphibola avellana* in New Caledonia. But the distribution of some of the genera is more important even than that of the species. *Nanina* spreads from India to China, the Philippines, Indian archipelago, and Polynesia, and is also found in Madagascar and the Mauritius, but not in Australia. *Amphibola* extends over Australia and Polynesia to Burmah. *Lymnæa* extends from Europe to India, China, and Java, and is also found in North America, but not in Australia. *Assiminea* is found in England, India, Celebes, Molucca Islands, and the Navigator and Friendly Islands, but not in Australia. The family *Ancylinæ*, or freshwater limpets, of which we possess two species, is found only in North and South America, Europe, and Madeira; and our common slug (*Milax antipodarum*) belongs to a genus found only in Europe and the island of Teneriffe. *Testacella*, of which we also possess a species, is only found in Europe and Teneriffe.

Our former connexion with Australia, however, is shown in the family of bitentaculate slugs (*Janellidæ*), a family which is found only in Australia and New Zealand—and also in the marine air-breathing limpets (*Siphonaria*), three of our species being found in Australia and Tasmania.

The land and freshwater univalves therefore show a stronger affinity to Polynesia and the Philippine Islands, by way of New Caledonia, the New Hebrides, Solomon Islands, and the Indian archipelago, than they do to Australia, although the distribution of the genus *Janella* shows that land communication once existed with Australia also. To South Africa and South America they exhibit no special affinity. Like the birds and fishes, they also show a slight anomalous affinity to Europe without any intermediate steps.

From the Chatham Islands eighty-two species of mollusks are known, of which nine appear to be peculiar to those islands; the rest are all found in New Zealand, including *Janella bitentaculata* and *Siphonaria scutulata*.

I know of two shells only from the Auckland Islands (*Patella illuminata* and *Vitrina zebra*), both of which are endemic.

Molluscoida.

Of Brachiopods we possess eight or nine species, of which two only (*Kraussia Lamarckiana* and *Magas Cumingi*) are found in Australia, the latter being also reported to occur in China. The genus *Rhynchonella* is only known living in the arctic portions of North America and Japan; but this anomaly

is not surprising when we remember that this genus existed during the Lower Silurian period; but it is interesting as affording us the clue by which other similar anomalies may be explained.

The New-Zealand Tunicata are as yet but little known. The genera *Ascidia*, *Boltenia*, and *Botryllus* are only found in Europe and North America. *Doliolum denticulatum* is found at the Molucca Islands.

Of the Polyzoa I am acquainted with eighty-nine species, of which thirty-one have been found nowhere else as yet; but it is probable that their range is very imperfectly known. Twenty-three of our species are found in European seas, while the intervening tropical seas appear to be almost destitute of this form of life. The chief point of interest in our Polyzoa is the great development of the massive species of *Cellepora* and of the coral-like family Idmoneidæ, which recall to mind the crag formation of England. Indeed one of our species, *Hornera striata*, is found fossil in the Crag; it is, however, also found fossil at Oraki, near Auckland, in beds of still older date. Considering how little attention has been paid to our Polyzoa, the number of known species indicates a rich fauna; and, indeed, the entire class seems to be more abundant in the southern than in the opposite hemisphere, and, like the petrels, contains many forms quite unrepresented in the north.

Insecta.

No New-Zealand naturalist who has collected insects on however small a scale in Europe can, I think, fail to be struck with the paucity in New Zealand, not only of species, but, in some orders, of individuals also. It is remarkable that in this country, whose indigenous warm-blooded animals are limited to birds and bats, on entering the bush, instead of finding the masses of decaying wood and leaves swarming with life, we find hardly a living creature*, while at the same time we are attacked by myriads of bloodthirsty mosquitos (*Culex acer*). It would certainly seem that abundance of food does not produce abundance of individuals in some orders (*e. g.* Coleoptera); neither does an absolute dearth of food in the *imago* state prevent the increase of individuals in others (*e. g.* Diptera). The swarms of sand-flies (*Simulium cæcutiens*), also, that greet us on the coast from the North Cape to the Bluff, where could they possibly have found food before the advent of man? Where, indeed, do they find it now in sufficient quantities?

* My experience in this respect in New Zealand is very different from that of Mr. Wallace in Singapore and Borneo, but similar to his in Celebes and Ceram.

Of beetles about 200 species inhabiting the land are described, the whole of which, I believe, are found nowhere else. These species are distributed into about 110 genera, of which about 35 are peculiar to New Zealand. A remarkable contrast to this is shown in the water-beetles, of which four only are known, two (*Cybister Hookeri* and *Colymbetes rufimanus*) being, I believe, endemic, and the other two (*Colymbetes notatus* and *Gyrinus natator*) being found in Britain. The genera best represented are, *Elater* with twelve, *Feronia* with eight, *Mecodema* with nine, *Xylololes* with seven, *Cicindela* with six, *Anchomenus* and *Maoria* with five each, and *Coptoma* with four species. Few beetles can be called abundant; the little green species (*Pyronota festiva*) so destructive to our fruit-trees, and a small brown species (*Colaspis brunnea*), common on the manuka (*Leptospermum*) in December and January, are perhaps the only two that deserve the epithet, although many can be called common. The beetles as a whole are, according to Mr. Pascoe, most closely allied to those of Australia.

The Hymenoptera are very poorly represented, about eighteen species only being as yet known. All are, I believe, endemic. Most of the genera are widely spread; but *Orectognathus* and *Dasycolletes* are peculiar to New Zealand. The poorness of our fauna in this order cannot be owing to unsuitableness of climate; for the honey-bee (*Apis mellifica*), which was introduced about thirty years ago, has spread over both islands *.

The Diptera are more numerous than the Hymenoptera, sixty species being known. This is just opposite to what obtains in most countries, including Australia and South America. Of these, *Tipula senex* is found in Australia, *Musca taitiensis* in Polynesia, and *Musca lœmica* in both Australia and Polynesia. Although most nearly allied to Australia, our dipterous fauna must have been derived from other localities as well; for the genus *Diphysa* occurs only in Mexico and Brazil, *Actina* in Europe, *Cœnosia* and *Sapromyza* in Europe and North America, and *Opomyza* in Europe and the Mauritius. No genus is endemic. Of the earwigs we possess one endemic species (*Forficula littorea*), found only near the sea-shore.

Of the Lepidoptera I know hardly any thing, and prefer waiting until Mr. Fereday has published his promised descriptions of the species before examining their bearing on the present subject. But one fact stands out prominently, viz.

* Mr. W. T. L. Travers informs me that the honey-bee was introduced into Nelson in 1842, and that wild bees were common in 1850.

that out of more than three hundred species only eight belong to the butterfly section (Fereday, Trans. N. Z. Inst. iv. p. 217), and several of these are world-wide stragglers.

Of Neuroptera about fifteen species are known. Of these, *Perla opposita* is found in Tasmania, and our representative of the white ants (*Calotermes insularis*) in Australia. This order appears to have more affinity with Tasmania than with Australia; and it is remarkable that the wide-spread genus *Perla*, which is found throughout North and South America, and from Europe through India to China and Japan, is also found in New Zealand aud Tasmania, but not in Australia. *Leptocerus* has also the same range, with the exception of not being known in China and Japan. *Hermes* extends from India to China and Java; it is also found in tropical Africa and South America, but not in Australia or Tasmania. *Palingenia* is found in Europe, India, North Africa, and North and South America, while *Philanisus* is peculiar to New Zealand. The Heteroptera are remarkable for their fragmentary character and wide distribution. The thirteen known species belong to thirteen different genera and nine families. *Arma Schellenbergii* is found in Australia and the Philippine Islands, *Cermatulus nasalis* in Australia and Tasmania, *Platycoris immarginatus* and *Rhaphigaster Amyoti* in Australia, *Lygæus pacificus* in Australia, Tasmania, and India, and *Nysius zelandicus* in Tasmania—thus leaving not more than seven endemic species, three of which have not yet been properly examined, and may therefore be found to be identical with species inhabiting other countries. One of the endemic species (*Rhopalimorpha obscura*), however, belongs to a genus found nowhere else.

In strong contrast to this stand the Homoptera, which include nineteen species, all endemic and belonging to two genera only, *Cicada* having twelve and *Cixius* seven species.

The number of species of Orthoptera I do not know; but in comparison with other orders it is well represented by both winged and wingless members; and the genera, as a rule, contain several species.

Whilst, therefore, the insect fauna as a whole shows its greatest affinity towards Australia, it also exhibits a connexion with other countries, more especially China and Europe. But the most remarkable fact is the great difference shown in this respect by the different orders. Whilst the Diptera, Neuroptera, Homoptera, and Orthoptera present the appearance, in part at least, of an old fauna, the Heteroptera are nearly all stragglers; and this strongly suggests the inference that at the time of the spreading of the former orders the

Heteroptera were not in existence. The same thing is seen in the difference between the moths and the butterflies, suggesting also that the latter were developed at a later period than the former; and there can be no doubt that when our insects are better known a careful comparison of them with similar faunas of other countries will afford a most instructive lesson.

With the exception of the Indian (*Blatta orientalis*) and American (*B. americana*) cockroaches, neither of which are common, the flea (*Pulex irritans*), the bed-bug (*Cimex lectularius*), several Aphides, the slugworm (*Tenthredo cerasi*), and the house-fly (*Musca domestica*), I am not aware of any insect that has been introduced unintentionally by man during the progress of colonization; for the ring-legged mosquito, which is supposed in Auckland to have been introduced by the troops from India, belongs to a species (*Culex argyropus*) not found elsewhere, and was sent home by Dr. Sinclair before the troops arrived. The only exceptions may perhaps be:—the black field-cricket, which, although inhabiting fields with us, and but rarely entering houses, appears to be identical with the house-cricket of Europe (*Acheta domestica*) and to have spread quite lately; and also a small dark-brown beetle belonging to the genus *Elater*, which is abundant in Auckland, but, to the best of my knowledge, is not found more than twenty miles out of that town.

Myriopoda.

Of Centipedes nine or ten species are now known, all of which are endemic. The genus *Lithobius* extends from North America, Europe, and North Africa to Singapore, but is not found in Australia; *Henicops* is found only in Chili and Tasmania, *Cryptops* only in North America and England; while *Cermatia* and *Cormocephalus* have wider ranges and are both found in Australia.

Arachnida.

Of Spiders we have about 100 species; but my knowledge of them is very limited. Mr. Pickard Cambridge, in a letter to me, remarks, "all the spiders you now send [from the Auckland province], except one or two, are strikingly European in appearance, nothing tropical-looking among them." Perhaps the most remarkable fact is the occurrence in the Chatham Islands of a species of water-spider (*Argyroneta*), of which only one other species, inhabiting Europe, is known. Spiders are very numerous in New Zealand, owing no doubt to the abundance of Diptera, on which order they chiefly prey.

Crustacea.

Of Crustaceans 106 species have been described as coming

from New Zealand; but my knowledge of this class also is at present very limited. Professor Dana has remarked that New Zealand has a greater resemblance to Great Britain in its Crustacea than to any other part of the world; but our common salt-water crayfish (*Palinurus Lalandii*) is found at the Cape of Good Hope and the Island of St. Paul.

Annelida.

Our marine Annelids have up to the present been almost entirely neglected. Of terrestrial forms we have two species of earthworm (*Lumbricus*) and a member of the peculiar genus *Peripatus*, found only in South America, the Cape of Good Hope, and the West Indies.

Scolecida.

The most remarkable fact in this class is the occurrence of two or three species of land-Planarians, the so-called "land-leeches," one or two of which belong to the genus *Bipalium*, found only in India, China, and Japan.

Echinodermata.

Of Echinoderms we have seventeen species of starfish, eight sea-urchins, and eight Holothurians. Of these, twelve starfish, six sea-urchins, and all the holothurians appear to be endemic. Of the others, *Ophionereis fasciata* is found at the Chatham Islands, *Pentagonaster pulchellus* at the Chatham Islands and in China, *Othilia luzonica* in the Philippine Islands and Vera Cruz; while we also possess species apparently identical with *Astropecten armatus* of South America and *Henricia oculata* of Europe. It is worthy of special remark that although Australia possesses several species of *Pentagonaster*, the Chinese species is not found there; so that it must have migrated to us direct, and not have come *viâ* Australia. We also possess a species of *Pteraster*, a genus found only in South Africa and northern seas. Of the sea-urchins, *Cidaris tubaria* and *Echinobrissus recens* are both found in Australia; but the latter appears to be very rare in New Zealand, as I have only seen one specimen, which is in the Colonial Museum.

Cœlenterata and Protozoa.

Of these very little is known. Our seven species of corals are all peculiar, as also appear to be many species of Sertularians and sponges; but I know of no facts among these lower animals that will help out the present investigation, except in the case of *Cryptolaria*, a genus belonging to the family Ser-

tulariidæ, and consisting of two species—one of which is found in New Zealand, and the other in Madeira.

Summary.

If now we review the evidence adduced, and select the more important points, we find in the distribution of the Struthious birds, the frogs, freshwater fishes, several shells (such as *Cyclina Kröyeri*, *Mytilus magellanicus*, *Anomia alecto*, *Barbatia pusilla*, *Chione Stutchburyi*, and *Ranella vexillum*), in the genus *Henicops* among the Centipedes, and *Peripatus* among the Annelids, evidence of a former great extension of land in the southern hemisphere; for these cases cannot all be accounted for by drifting icebergs. With the exception of the shells and two freshwater fishes, no species, however, is common to New Zealand and South America on the one hand, nor to New Zealand and South Africa on the other; for I omit from consideration the species of marine fish, as they might perhaps have crossed at a later date. In the frogs the genera, and in the birds the families are different. This perhaps indicates a very long interval since the separation of these countries took place; but differentiation of form, even in closely allied species, is evidently a very fallacious guide in judging of lapse of time, and a surer one is afforded us in the absence of Mammalia from New Zealand; for it is evident that if the marsupials that now inhabit Australia, or the placental mammals that inhabit South America, had been in existence at the time of the distribution of the Struthious birds, some members would have found their way to New Zealand, and would have remained upon it with the moas. This antarctic continental period must therefore have preceded the spread of the Mammalia into the southern hemisphere. Besides this continental period we have evidence in *Eudynamis taitiensis*, *Naultinus pacificus*, *Amphibola avellana*, *Musca taitiensis*, and in the genera *Ocydromus* and *Nestor*, of a Polynesian continent quite unconnected with Australia, but including Lord-Howe Island, Norfolk Island, and New Caledonia; while by *Helix coniformis*, *H. rapida*, *H. radiaria* and *H. vitrea* we can prove a close connexion with the New Hebrides, Solomon Islands, Louisiade archipelago, and the Admiralty Islands. By *Nanina* among land-shells and *Assiminea* among freshwater shells, we prove a connexion also with the Navigator and Friendly Islands; and these genera take us north through the Molucca Islands, Celebes, Borneo, and the Philippines to China, where we again come across many New-Zealand species and genera. The most important are:—*Ditrema*, *Torpedo*, and *Anguilla latirostris* among fishes; *Mytilus smaragdinus*, *Phorus*, *Rotella*, *Calyptræa*, *Cassidula mustelina*, *Lymnæa*, and

Rhynchonella among shells; *Perla* and *Hermes* among insects; *Lithobius* among centipedes; *Bipalium* among the Scolecida; and *Pentagonaster pulchellus* and *Othilia luzonica* among the starfish,—none of these, it must be remembered, being found in Australia. The absence of Mammalia, however, in New Zealand shows that this line of communication was never continuous land; but the absence from Australia of the forms that I have mentioned shows that the connexion along the whole line was closer at every point than it was with that continent; and this leads to the further conclusion that this line of communication existed at a later date than the connexion of New Zealand with Australia.

The close relationship of the Chatham and Auckland Islands in all their natural productions to New Zealand, and the far greater difference between New Zealand and the islands more to the north, as well as the large number of species of moa lately inhabiting these islands, show that another and smaller continent, or perhaps a large island, existed at a still later period, but has since subsided; and this must bring us nearly to the recent period, or the difference between New Zealand and the Chatham Islands would be greater.

The geographical distribution, therefore, of the New-Zealand fauna points to the following conclusions:—

1. A continental period, during which South America, New Zealand, Australia, and South Africa were all connected, although it is not necessary that all should have been connected at the same time; but New Zealand must have been isolated from all before the spread of the mammals; and from that time to the present it has never been completely submerged. This continent was inhabited by Struthious birds and by *Hymenolaimus*, *Notornis*, *Hinulia*, *Mocoa*, *Galaxias*, *Prototroctes*, *Liopelma*, *Janella*, *Amphibola*, *Henicops*, and *Peripatus*, and further to the north by *Megapodius*—and probably also by many forms peculiar to New Zealand, such as *Strigops*, *Keropia*, *Xenicus*, *Heteralocha*, *Anarhynchus*, *Naultinus*, &c. Of course in mentioning these names I do not mean that all the forms were the same then as now, but that the ancestors of these genera lived on the old antarctic continent.

2. Subsidence followed; and the evidence then points to a second continent stretching from New Zealand to Lord-Howe Island and New Caledonia, and extending for an unknown distance into Polynesia, but certainly not so far as the Sandwich Islands. The fact of mammals being found in the New Hebrides, Solomon Islands, and New Ireland shows that between New Caledonia and the New Hebrides a narrow strait must have existed cutting off land communication; but these were connected with China, either directly or by a chain of

islands. This second continent received from the north those forms already enumerated, together probably with *Sphenœacus*, the rails, and the starlings; at the same time it received from Australia the honey-eaters, *Certhiparus*, *Gerygone*, *Petroica*, *Rhipidura*, and others, and from that time to the present has been occasionally receiving additional birds. It will also be noticed that very few of the birds of the middle palæotropical region came down this line of communication, no pheasants, woodpeckers, grackles, or finches; while Australia, in its wood-swallows (*Artamus*), pittas, quails, and numerous finches, shows now some affinity to this region. This can be best explained by supposing that the New-Zealand line of communication was broken up before these birds came into existence, and that further changes have since taken place in the lines of easiest communication; indeed the fact of such forms as the elephant, tiger, and bear being found in Sumatra and Borneo, marsupials in Celebes, the Moluccas, Solomon Islands, and New Hebrides, and the presence of an emu in New Guinea, and a cassowary in Australia, prove that changes in the distribution of land have since taken place; but it is foreign to the object of this paper to speculate on these here. This second continent was also inhabited by most of the orders of insects, although perhaps not in great abundance; but Heteroptera and the butterfly section of the Lepidoptera were absent.

3. Subsidence again followed, and New Zealand was reduced for a long time to a number of islands, upon many of which the moa lived. This was followed by—

4. Elevation: these islands were connected and a large island existed disconnected from Polynesia. This was once more followed by—

5. Subsidence; and the geography of this part of the world assumed somewhat of its present form.

Geological Evidence.

Such are, I think, the deductions that may be fairly drawn from a study of our fauna. It remains now to examine the geological and palæontological evidence, and see whether it agrees with that derived from zoology, and then to try to fix with as much accuracy as possible the dates of the principal movements of the earth's surface which have gradually led to the present state of the New-Zealand fauna.

Hardly any thing is yet known of the palæozoic rocks of New Zealand. The earliest fossil shells described are almost identical with those living in Europe during the Triassic period; but the only known plant is *Dammara australis*

(Hochstetter's 'New Zealand,' p. 57), a genus still living in New Zealand, but also found in Australia, New Caledonia, New Hebrides, Fiji, and the Indian archipel[illegible]

An interval then occurs; and the next formation probably belongs to the Jurassic period. In this we find *Belemnites aucklandicus*, which can hardly be distinguished from *B. canaliculatus*, and *Astarte wollumbillaensis*. The ferns, too, found so plentifully near Port Waikato, in the Clent hills, at the Mataura, and at Waikawa harbour are considered by Professor M'Coy to be identical with Australian ferns from the same formation. At the close of this period movements on an extensive scale commenced in New Zealand; the land was upheaved, and an extensive mountain-chain formed. A long blank now occurs in our geological record (see Geol. Reports, 1872, p. 105), the next formation belonging to quite the uppermost part of the Secondary epoch, later, I believe, than the white chalk of England. In it we find remains of dicotyledonous plants and large Saurians belonging to the genera *Crocodilus*? and *Plesiosaurus*. Here, also, we find three fossil shells (*Dentalium majus*, *Lucina americana*, and *Cucullæa alta*) similar to those found in South America, one of which, *Lucina americana*, is found in the Lower Cretaceous rocks of Tierra del Fuego, and the other two in the Miocene formations of Patagonia and Chile—thus showing that during this blank in our geological record an intimate connexion had existed between New Zealand and South America. The disposition, however, of these beds shows that the New-Zealand Alps were not submerged. A long interval now follows, during which New Zealand was again upheaved; and the next rocks that we find are of Upper Eocene date (Geol. Reports, 1872, p. 182). From that time until the close of the Miocene period New Zealand was greatly depressed and divided into several islands; but at the close of the Miocene period it was once more upheaved. During this period we find several South-American Miocene shells not met with in the older formation, as well as several Australian ones. During the Newer Pliocene period it again subsided, and the Wanganui beds were deposited. From that time I can see no evidence of the land having ever stood at a higher level than it does at present; but as the later changes in the physical geography of New Zealand have a most important bearing on the present condition of its fauna, beyond the scope of my present inquiry, I propose treating the subject in a separate paper*. The geological evidence is therefore that since the Jurassic period there have

* *Vide* "On the Date of the last Great Glacier Period in New Zealand" (Trans. New-Zealand Institute, vol. v.).

been three principal upheavals in New Zealand, in the Lower Cretaceous, Lower Eocene, and Older Pliocene periods respectively, and that these were divided by two insular periods, viz. during the Upper Secondary (Danian) and from the commencement of the Upper Eocene to the close of the Miocene, thus agreeing completely with the zoological evidence.

The dates assigned by the geological evidence also agree well with those derived from zoology. We have seen that it is necessary to suppose that the first great antarctic continental period was anterior to the date of the spread of the mammals southwards. Now a few marsupials are known in the Triassic period; but it is quite possible either that they spread very slowly, or that barriers existed that prevented any southward migration. In the Eocene period, however, some placental mammals were in existence, although marsupials (not of Australian types however) still formed in Europe the principal mammalian life; and if the supposed barriers to a southward migration were still in existence, we know, from what happened in the northern hemisphere, that the whole, or nearly the whole, of the marsupials would be exterminated. The marsupials, therefore, must have migrated south not later than the Eocene period; and as we know that our connexion with Australia and South America must have been before that migration, it follows that the first, or Lower Cretaceous, period of upheaval must have been the time of the antarctic continent. This is rendered still more probable by the fact that our Jurassic fossils show a connexion with Australia only, while our Upper Secondary fossils show for the first time a relation to South America. The fact, too, of the Cretaceo-Oolitic rocks of Tierra del Fuego having been largely disturbed, metamorphosed, and broken through by dykes of greenstone, shows that extensive elevatory movements have taken place there also since they were deposited. It is therefore to the Lower Cretaceous period that we must probably look for the time of the dispersion of the Struthious birds. With regard to the date of the second or Polynesian continental period, the only zoological evidence we have is that it probably preceded the wide dispersion of the Hemiptera and the butterfly section of the Lepidoptera. This, therefore, could not have been later than the Eocene; for a fossil butterfly (*Vanessa pluto*) has been found in the Lower Miocene deposits of Radaboj in Croatia, and fossil Heteroptera in the Miocene beds of Œningen in Switzerland. The elevation during the Lower Eocene period was therefore probably the one which formed the continent that I have described as including New Caledonia and some of the Pacific islands. At this period probably Northern

Australia was submerged, and the southern portions of Australia and Tasmania formed one large island; while New Guinea, including the Solomon Islands and New Hebrides on the south and the Molucca Islands on the north, formed another large island, divided from the New-Zealand island or continent by the straits between New Caledonia and the New Hebrides.

This was the time of the migration from China southwards; and it is worthy of notice that at the same time a large ocean existed from Southern Europe to China, in which the nummulitic limestone was being deposited. Would it be too bold to speculate that it was along the shores of this ocean that those fish, crustaceans, and shells migrated which are now found in the North Atlantic or Mediterranean on the one hand, and in China or Japan on the other, but not on the southern shores of Asia, and that the anomalous distribution of European forms of fish, shells, &c. in New Zealand may be traced to the same route? This same period of sea communication between Europe and Japan will also probably have been the time of the land connexion that once existed between India, Madagascar, and Africa (the Lemuria of Dr. Sclater), as proved by the recent freshwater fish and birds, as well as by the Miocene mammalia*; and to this period we may also refer the origin of the curious affinity between some of the birds of Celebes and Africa. The long insular period during the Upper Eocene and Miocene times will therefore be the period of specific change in the moas, while the Older Pliocene upheaval will be the time of the mingling of the various species in New Zealand and the peopling of the Chatham and Auckland Islands. The Newer Pliocene was the time when the two islands of New Zealand were divided, and also the period when the Chatham and Auckland Islands were separated from them; but the latter occurrence probably preceded the former by a long interval.

Such appears to me to be the hypothesis most capable of accounting for the present fauna of New Zealand.

The objection, however, may be fairly raised that, if it is true, evidence of its truth ought to be also found in the flora of the country, which is not the case. I fully acknowledge the force of this argument, but think that some slight evidence can be found in the phænogamic flora. The distribution of

* Professor Huxley thinks (Quart. Journ. Geol. Soc. 1870, Ann. Address, p. 56) that the land communication between India and South Africa was caused by the upheaval of the nummulitic sea; but it seems to me more probable that the land communication was by the shores of that sea.

Eucalyptus, for instance, is somewhat parallel to that of the marsupials, and can be only explained in the same way. *Stilbocarpa polaris* has its nearest allies in China and the Himalaya Mountains; while the distribution of *Metrosideros*, *Ligusticum*, *Angelica*, and, perhaps, *Veronica* implies a connexion between New Zealand and Asia not by way of Australia. This connexion is obscured by the great preponderance of Australian and South-American forms, but still furnishes an indistinct copy of the bolder outline sketched out by the fauna. This is owing to the wider distribution of genera among plants than among animals; and to me it appears to prove that the flora of a country, as a whole, is of a more ancient date than its fauna. Among the cryptogamic plants no trace of this outline can be discerned, as also is the case with the lower classes of the animal kingdom, owing to the genera having been, so to say, universally spread before the last migration from Asia took place.

That the facies of a fauna and flora should date back from so long a period as I suppose, is certainly at variance with ordinarily received opinion; but from a study of the fauna and geology of New Zealand I do not see how we can escape from the conclusions that I have arrived at. I am well aware, however, that much more has to be done in the geology and natural history not only of our own islands, but also of the surrounding countries, before they can be considered satisfactorily proved; but I think that it will be easier afterwards to prove this hypothesis, or to disprove it and point out a more correct one, than it would be to detect it if the discussion had been postponed to a future period, when the more salient points will probably be obscured by the mass of facts which will then have accumulated. Such, at least, is my hope; but whether I am mistaken or not I leave others to judge.

XIV.—*Descriptions of New Genera and Species of* Heteromera, *chiefly from New Zealand and New Caledonia, together with a Revision of the Genus* Hypaulax *and a Description of an allied New Genus from Colombia.* By Frederick Bates.

[Concluded from p. 24.]

Titæna, Erichson.

For the better understanding of the two new genera that follow it is necessary to add to the published descriptions of the genus *Titæna* as follows:—Prosternum narrow and very

abruptly elevated between the coxæ, a little concave in front of them, the extreme anterior portion always distinctly horizontal: prothorax very convex, slightly but distinctly rounded at the sides, lobed at the middle of the base, and very strongly and deeply punctured: lateral reflexed margins of the elytra distinctly continued along the basal margin up to the scutellum: the punctuation of the surface more or less irregular, with the interstices more or less strongly, transversely, and reticulately rugose; and the body is ordinarily distinctly pilose.

Titæna columbina, Erichson.

The colour in this species varies from purple to green, the front margin of prothorax and sutural edging of elytra being ordinarily of some shade of green; sometimes, however, it is coppery, golden, greenish cyaneous, &c.; the reflexed lateral margins are generally (except at the apex) of the same colour as the sides of the elytra; the legs are of a more or less dark piceous, sometimes with a green tinge. The head and prothorax are more or less closely covered with deep punctures, the latter slightly but distinctly rounded at the sides; the elytra are rather strongly punctured, with a disposition to a seriate arrangement; the intervals distinctly transversely and somewhat reticulately rugose; and the body is distinctly pilose.

Length $4\frac{2}{3}$–$5\frac{1}{3}$ lines.

Hab. Australia; generally distributed. Eight examples in my collection.

Var.? *virida.*

Smaller ($4\frac{1}{3}$ lines). Head and prothorax bronzed green: elytra dark green, without distinct sutural edging, except slightly towards the apex: underside and legs piceous: flanks and sides of abdomen covered with large, round, deep punctures: prothorax distinctly broadest in front; the angles very distinct, slightly produced; sides distinctly and slightly curvedly narrowed from before the middle to the hind angles; median basal lobe more produced behind, and the punctuation more regular.

Hab. Melbourne. One example.

Titæna pulchra, n. sp.

Near *T. columbina*. Very thinly pilose: head broadly rounded in front; epistoma short, convex, and, together with the antennary orbits, pitchy red, the suture moderately impressed; rest of the head and the prothorax bronzed green, the punctuation as in *T. columbina*: elytra dark bronzed green, the base and sides (partly) golden green; the suture with a

stripe of dark bluish green, then a narrower stripe of purple, then a broad stripe of golden green gradually deepening into the dark bronzed green of the rest of the elytra; reflexed lateral margins metallic purple; punctuation more regular and less numerous than in *T. columbina*; the punctures distinctly arranged in lines and somewhat close-set; the intervals with a row of similar but more distant (about one to three) punctures; the intervals are also distinctly less rugose than in *T. columbina*: underside tinged with green; flanks and sides of abdomen moderately punctured; legs castaneous; palpi and antennæ paler.

Length 3½ lines.

Hab. New South Wales. One example.

Titæna alcyonea, Erichson.

Easily to be distinguished from either of the preceding by the body not distinctly pilose. The head and prothorax black, without any metallic tinge, very closely and evenly punctured (almost cellulose-punctate): the elytra more densely punctured; the larger punctures arranged in lines, with smaller but equally close-set punctures on the intervals; the intervals are more decidedly (especially near the base) rugose even than in *T. columbina*, and are at the apex united and distinctly costiform; the colour is dark green, with dark purplish reflections, the suture towards the apex being golden green with purplish reflections; the lateral reflexed margins are brilliant metallic purple: the epistoma is longer and the antennary orbits much more prominent than in *T. pulchra*; in both they are pitchy red: underside piceous; legs castaneous; antennæ and palpi paler.

Length 3½–4¼ lines.

Hab. Albany, West Australia. Three examples in my collection.

Var. *ruficollis*.

Prothorax dull red; epipleural fold and underside yellowish.

Hab. Albany. One example.

ARTYSTONA, n. g.

Differs from *Titæna* in the prosternum less strongly and abruptly elevated between the coxæ, not distinctly concave in front of them, the anterior horizontal portion longer; the head consequently is less deeply imbedded in the prothorax, and does not repose on the front coxæ. Prothorax squarer, less convex, truncated at base and apex, more or less

punctured. Lateral reflexed margins of the elytra distinctly terminating at the humeral angle; the punctuation of the surface of the elytra is in rows of fine punctures, the intervals being convex, interrupted, and forming, especially at apex, series of oblong tubercles. Legs longer and (especially the tarsi) more slender. Body not pilose.

Artystona Erichsoni, White (*Titæna*).

The *Titæna interrupta*, Redtenb., must be referred to this species, the type specimens of which are in my collection.

The head is remotely punctured; the prothorax more closely punctured, with the interstices quite smooth.

Hab. New Zealand. Three examples in my collection.

Artystona Wakefieldi, n. sp.

Readily to be distinguished from *A. Erichsoni* by the colour entirely of a dark shining brown; the head and prothorax much more closely and rugosely punctured; and, as a secondary character, the intervals on the elytra (especially at sides and apex) are more strongly interrupted and more distinctly tuberculiform.

Length 5 lines.

Hab. New Zealand. Five examples.

Examples of this species in Doué's collection were labelled "*Strongylium volvulum*, Klug."

Artystona rugiceps, n. sp.

Of the same colour as the preceding, but smaller; form decidedly less parallel; eyes narrower, appearing outwardly conical when viewed from above, a distinct space between their upper margin (which is entire) and the antennary orbits; these latter very convex, subangulately rounded: head much more strongly rugosely punctured; the punctures larger, rounder, and deeper; punctures on prothorax not more numerous than in *A. Wakefieldi*, but larger, rounder, and deeper; the interstices not at all rugulose: elytra sculptured as in the preceding, but the form is elongate-oval.

Length $3\frac{2}{3}$–$4\frac{1}{4}$ lines.

Hab. New Zealand. Seven examples.

This is the species dispensed by Dr. Schaufuss under the name of "*Helops? porcatus.*"

Callismilax, n. g.

Differs from *Titæna* in the prosternum being vertical and

widely concave in front, direct from the anterior border, and much wider (and usually concave) between the coxæ; the process wider, more or less horizontal, and frequently widely concave or excavated down its length, with the lateral margins upturned, the end more or less prominent and broadly rounded or truncated. The prothorax moderately convex, subquadrate, wider at base than at apex, broadly rounded or lobed at base, and always more or less finely punctured. The reflexed lateral margins of the elytra distinctly terminate at the humeral angle; the punctuation of the surface of the elytra is ordinarily fine, distinctly seriate or not, the intervals more or less flat; sometimes, however, the punctuation is more or less foveate, the intervals more or less convex and confluent. The body is not pilose; the form is varied, but never so cylindric as in *Titæna*. The eyes above are sometimes rather narrow and oblique; the convexity of the elytra, the stoutness of the legs, the length of the tarsi, &c. are also subject to specific variation.

The form of the prosternum and the totally different style of sculpture on the elytra will at once serve to distinguish this genus from *Artystona*.

Callismilax ænea, Montrouz. (*Strongylium*).

Elliptic. Entirely of a brilliant brassy green above. Head and prothorax finely, clearly, and not very closely punctured; the latter distinctly emarginate in front; the angles slightly prominent, distinctly broader at base than at apex; sides slightly incurved from the front to the hind angles: elytra finely and irregularly punctured, the larger punctures manifesting a disposition to a seriate arrangement, especially at the sides and towards the apex; punctuation obsolete at apex; intervals shortly costiform at apex: underside bronzed green; legs rather stout, steel-blue or violet; intercoxal process sparsely punctured: eyes above subrotundate: prosternal process subhorizontal, feebly rugulosely punctured, broadly and obliquely concave or excavated; the sides upturned, and angulate between the coxæ: mesosternum a little declivous and arcuately concave in front.

Length 5½ lines; width of elytra across the middle 2½ lines.

Hab. New Caledonia. Two examples, obtained from Doué's collection.

Callismilax venusta, n. sp.

A little smaller and more parallel than *C. ænea*. Head and prothorax deep black, finely and closely punctured and rugulose; the punctures distinctly more numerous and less strongly

impressed than in *C. ænea*, and the prothorax decidedly more convex: epistoma very short: head very strongly impressed across the base of the epistoma: prothorax subquadrate, less distinctly emarginate in front than in *C. ænea*; sides subparallel, a little wider at base than at apex: elytra of a beautiful metallic purple, metallic green at the base and at the extreme apex, and with an irregular, outwardly curved, transverse metallic-green band behind the middle; lateral reflexed margins metallic purple, except at the apex, where they are metallic green: punctuation nearly as in *C. ænea*, but a little closer and shallower: underside and legs pitchy black, without any metallic tinge or colour; intercoxal process more closely punctured than in *C. ænea*; legs rather stout: eyes above rather narrow, oblique: prosternal process bent down behind the coxæ, coarsely rugose-punctate, obliquely impressed at each side and along the base, which is broadly truncated; mesosternum declivous, and but slightly concave in front.

Length 5 lines; width of elytra across the middle 2 lines.

Hab. New Caledonia. One example.

Callismilax Mulsanti, Montrouzier (*Strongylium*).

Very near the preceding, but distinctly narrower, more parallel or cylindric. The head and prothorax with a distinct bluish tinge; the punctuation on the latter more open and distinct, not rugulose; epistoma a little longer, the transverse impression at base of epistoma less strongly impressed: elytra metallic green, with the base and apex metallic purple, each with eight very distinct rows of punctures; the intervals finely and not closely punctulate, and costiform at the apex: underside of a bluish green; intercoxal process more strongly but not more closely punctured; legs rather stout, steel-blue; eyes broader and less oblique; prosternal process subhorizontal, nearly smooth, strongly obliquely impressed at each side, the middle (convex) portion a little produced and rounded behind; mesosternum a little declivous and deeply concave in front.

Length 5¼ lines; width of elytra across the middle 1¼ line.

Hab. New Caledonia. One example, obtained from Doué's collection.

Callismilax Mäklini, n. sp.

Elongate-elliptic, convex, shining. Head and prothorax purple, with green patches and reflections, rather strongly and closely punctured (especially at the sides of prothorax): prothorax transversely subquadrate, shorter than in any of those preceding; apex scarcely emarginate, and a little narrower than the base: elytra very dark bronzed green, each with

eight rows, besides a short scutellar one, of foveate impressions, which, small and shallow at the base and by the suture, become gradually larger and deeper at the sides and apex; intervals reticulately elevated, most strongly so at the sides and apex; lateral reflexed margins dark bronzed green: underside and legs (more especially on the metasternum, abdomen, and femora) metallic green and purple; intercoxal process somewhat coarsely punctured; prosternal process subhorizontal, sulcate at each side, the sulci and basal margin very coarsely punctured, the middle portion rugose-punctate; mesosternum subvertical and deeply and broadly concave in front; eyes above subrotundate; legs rather stout.

Length $5\frac{1}{3}$ lines; width of elytra across the middle 2 lines.

Hab. New Caledonia. One example.

Instantly to be distinguished from all the preceding by the foveate-punctate elytra.

Callismilax Deplanchei, n. sp.

Somewhat broader and less convex than any of the preceding. Head and prothorax black, the latter with green reflections: elytra dark green, the suture narrowly obscure purplish: head moderately punctured, the punctures shallow; front slightly concave: prothorax very strongly transverse, the punctuation much larger and deeper than on the head, the interstices faintly rugulose; apex slightly emarginate, and but little narrower than the base: elytra obliquely expanded at the sides for a short distance from the humeral angle, thence very gradually narrowed to the apex; seriate-punctate, the punctures much larger (foveate) and rugged at the sides and apex; intervals punctured, irregularly transversely, and at the sides and apex rather strongly rugose: underside pitchy black; intercoxal process sparsely punctured: legs rather stout; tarsi elongate; femora steel-blue; tibiæ purplish, with violet reflections; prosternal process subhorizontal, almost smooth, concave, and the edges strongly upturned, between the coxæ, obliquely impressed at each side, the middle portion produced and a little upturned behind; mesosternum a little declivous and broadly concave in front: eyes above rotundate.

Length $5\frac{3}{4}$ lines; width of elytra across the middle $2\frac{1}{3}$ lines.

Hab. New Caledonia. A single example, received from Paris, labelled "*Olisthæna Deplanchei*, Fauvel." I am not aware of any published species bearing that specific title that could by any possibility be the same as ours.

Easily to be separated from *C. Mäklini* by its broader form, strongly transverse prothorax, different colour, sculpture, &c.

In the following two species the body is much less convex (subdepressed), the elytra more loosely embracing the sides of the abdomen, and much wider at base than base of prothorax, and the tarsi are more elongate. *C. Deplanchei* may be considered the intermediate form.

Callismilax ruficornis, n. sp.

Elongate, subparallel, subdepressed. Head and prothorax deep shining black, finely and closely punctured, the punctures very shallow, the transverse impression at base of epistoma very broad; the front very convex: prothorax at apex slightly emarginate and a little narrower than the base: elytra green, with purple reflections; sides obliquely expanded for a short distance from the humeral angle, thence subparallel; the apex very narrowly rounded; on each elytron eight distinct, but shallow, rows of punctures, obsolete at the apex; the intervals faintly punctate and, except the marginal one, not costiform at the apex: underside shining black; legs rather slender, dark castaneous; tarsi elongate; intercoxal process sparsely punctured and longitudinally wrinkled; antennæ elongate, slender, and, together with the tarsi, ferruginous red: eyes above narrow, strongly oblique, their greatest convexity near the posterior (outer) border: prosternal process horizontal, lightly grooved at each side and along the base, prominent and subtruncate behind; mesosternum a little declivous, and broadly, but not deeply, concave in front.

Length 5 lines; width of elytra across the middle 1¼ line.

Hab. New Caledonia. One example.

Callismilax grandis, n. sp.

The largest and most expanded form in the genus. Metallic green, with (especially on the elytra) a brassy tinge; the hind margin of the prothorax obscure violet: head and prothorax finely punctured, the punctuation very clear, the interstices not at all rugulose; front distinctly less convex than in *C. ruficornis*: prothorax distinctly arcuate-emarginate in front, straight at the sides, wider at base than at apex: elytra at base more than half as wide again as the base of prothorax; sides obliquely expanded for a short distance from the humeral angles, thence gradually contracted to the apex, which is somewhat acuminate; seriate-punctate, confusedly so at the base, the punctures very fine, obsolete at the apex; the intervals very finely and not closely (but much more numerously and distinctly than in *C. ruficornis*) punctured, and distinctly costiform at the apex; reflexed lateral margins wide: under-

side a little darker and less metallic than the upper; intercoxal process more closely punctured and rugose than in *C. ruficornis*: legs rather stout, steel-blue with purplish reflections; tarsi elongate; antennæ rather long, slender, the outer joints rufescent; prosternal process horizontal, lightly wrinkled, broadly concave, the end broadly rounded; mesosternum declivous, and broadly and somewhat deeply concave in front: eyes above slightly oblique.

Length 7 lines; width of elytra across the middle 3 lines.

Hab. New Caledonia. One example.

The following species, at a first glance, appears to be foreign to the genus; it possesses, however, all the essential characters, the difference being only one of facies.

Callismilax sternalis, n. sp.

Elongate-oval, very convex. Head and prothorax black; the former finely, the latter more strongly punctured; apex of prothorax emarginate, narrower than the base, front angles somewhat prominent, acute; a shallow fovea on each side of the middle, at the base: elytra subovate, very convex, of a somewhat purplish-violet (or plum) colour, appearing in some lights to have a slight castaneous tinge, the suture and base brownish; seriate-foveate, the foveæ obsolete at the base, the first three or four rows from the suture shallow and linear for half their length from the base, the rest deep, large, very irregular, more or less angular, with costiform intervals; intervals impunctate, save at the base, where are a few small scattered punctures; a large indentation on each side at about the middle; lateral margins narrow, and strongly reflexed at base and apex, flat, broad, and strongly sinuous in the middle: underside dark brown; intercoxal process very strongly and coarsely cellular-punctate: legs rather stout, violet; outer joints of antennæ larger than ordinary; prosternal process very wide, reddish testaceous, obliquely impressed at each side, the margins a little elevated and thickened, the end broadly truncated; mesosternum declivous, and broadly but shallowly concave in front: eyes above decidedly oblique.

Length 3½ lines; width of elytra across the middle 1¾ line.

Hab. New Caledonia. One example.

Adelium zelandicum, n. sp.

Oblong, subparallel, attenuate behind, depressed; bronzed brown, more or less metallic. Head short, immersed up to the eyes in the prothorax, somewhat rounded in front; epi-

stoma very short, convex, distinctly emarginate in front, the suture more or less distinctly marked, arcuate; one or more impressions between the eyes; rather strongly and somewhat irregularly punctured and rugose: labrum prominent, transverse; angles strongly rounded, notched at apex: antennæ moderate, a little longer in male than in female, perfoliate (distinctly so in male), gradually thicker, and a little compressed outwardly; the joints obconic, all longer than wide, 3 shorter than 4 and 5 united, the last largest of all, obliquely rounded at apex: prothorax subquadrate, wider than long; sides anteriorly moderately incurved, posteriorly subparallel, or very slightly sinuously contracted; apex arcuate-emarginate, and distinctly margined throughout; front angles a little depressed, obtuse; base closely applied to and overlapping the base of the elytra, strongly emarginate at the middle, the hind angles obtuse; more or less finely, and somewhat irregularly, punctured, more or less distinctly wrinkled at the sides and at the hind angles, distinctly (especially at the sides) but very finely pubescent; the whole surface more or less uneven by numerous irregular foveate impressions, the most constant being the rounded fovea at each side of the middle at the basal margin: scutellum rather large, convex, punctured, transversely curvilinearly triangular: elytra but little broader at base than the base of prothorax, narrowed behind, finely pubescent, with numerous striæ, these sometimes a little irregular, more or less finely impressed, but very rarely (in but one out of the ten examples before me) distinctly punctured; the intervals (except at the apex) flat, very finely and closely muricate-punctate, here and there interrupted by irregular transverse impressions, which sometimes assume the form of rounded foveæ: underside bronzed brown, finely pubescent: prosternum slightly compressed in front of the coxæ, its process rather narrow, convex, finely margined at the sides, very obtuse and not produced behind; intercoxal process wide, subtruncate at apex: legs reddish brown; tarsi and antennæ ferruginous; the four front tarsi distinctly more expanded in male than in female; inner edge of hind tibiæ fringed with longish hairs in the male.

Length 3½–4½ lines.

Hab. New Zealand. Ten examples.

There are some points of resemblance, especially in the form of the head, between this species and the *Cymbeba dissimilis* of Pascoe; and, did I hold that genus unmistakably distinct from *Adelium*, I might be inclined to place this with it as a second species. It has not, however, the produced and pointed prosternal process, the distinctly marked-off epipleuræ of the

elytra, nor the apically rounded intercoxal process, as in *Cymbeba dissimilis*. I possess examples of this latter coming from Cape York, New Hebrides, and New Caledonia.

Pheloneïs harpaloides, White (*Adelium*).

This genus was created by Mr. Pascoe (Journ. of Entom. ii. p. 483) to receive the *Adelium harpaloides* of White. The *Amarosoma simulans* of Redtenbacher I believe to be the same thing. According to my view it cannot be separated from *Adelium*, which is evidently a polymorphous genus. Should this view be correct, the name will require changing, there being already an *Adelium harpaloides*, Boisduval; I should suggest the name *amaroides* for it. The male of this species has the lower edge of the four hind femora emarginate and fringed with long hairs.

Messrs. Gemminger and Von Harold, in their great Catalogue, have included the species in the genus *Pseudhelops* of Guérin. This is manifestly wrong, *Pseudhelops* having, amongst other differential characters, the penultimate joint of the tarsi simple, not subbilobed. The same authors have most unwarrantably sunk the genus *Coripera* of Pascoe under *Pseudhelops*; *Coripera* is evidently a good genus, very near to, but quite distinct from, *Adelium*.

Amarygmus zelandicus, n. sp.

Form and general aspect of *A. hydrophiloides*, Fairm.; but differs from it, and from all the other species of the genus known to me, in having the four hind tibiæ attenuate at the base, and then expanded, and strongly sinuous (almost broadly dentate in the hind pair) at the inner margin.

Prothorax green, with a slight bluish tinge, brassy at the sides: elytra green, with a brassy tinge, the sutural region a little coppery; head and prothorax finely and, except on the epistoma, not very closely punctured: elytra punctate-striate, the striæ distinctly deeper and the punctures a little larger than in *A. hydrophiloides*; intervals finely and not closely punctulate: underside and legs piceous; tarsi and basal joints of antennæ paler; lower margin of the four posterior femora emarginate; anterior tarsi strongly expanded, the intermediate thickened; antennæ elongate.

Length 3¼ lines.

Hab. New Zealand. One example.

The peculiarities observable in the tibiæ and tarsi of this species are either sexual or subgeneric.

Techmessa, g. n. (*Œdemeridæ*).

Mentum transversely quadrangular. Last joint of maxillary palpi cultriform, acute at apex. *Mandibles* bifid at apex; *labrum* short, slightly sinuously truncated in front. *Head* short; *epistoma* broadly and squarely truncated in front. *Eyes* large, slightly transverse, entire, more (*concolor*) or less (*telephoroides*) strongly prominent. *Antennæ* inserted on slight prominences in front of, and quite distinct from, the eyes: joint 1 swollen, pyriform; 2 a little shorter than 3, and both obconic; 3 not more than half as long as 4; 4–10 subequal, cylindric (*concolor*) or elongate-obconic (*telephoroides*); 11 a little longer than 10, subfusiform. *Prothorax* scarcely wider than long and convex in *concolor*; distinctly wider than long, subdepressed, and somewhat unequal in *telephoroides*; truncated at base and apex; sides rounded, abruptly incurved anteriorly, gradually contracted posteriorly, rather strongly grooved or margined along the base. *Elytra* elongate, parallel, scarcely convex, somewhat broadly rounded at apex. *Femora* sublinear; *tibiæ* armed with two distinct spurs at apex; the two penultimate joints of the *tarsi* rather short, expanded, and spongy pubescent beneath. *Abdomen* of five free joints. *Body* more (*telephoroides*) or less (*concolor*) linear, shortly pilose.

Of all the published genera of the Œdemeridæ the present seems to me to approach nearest to *Cycloderus*. It is, however, at once to be distinguished from that genus, and from all the others of the family known to me, by the short third joint of the antennæ.

Techmessa concolor, n. sp.

Black, a little shining; everywhere rather densely clothed with a shortish, semierect, brownish pile. Head and prothorax coarsely punctured and rugose; the punctures more crowded on the front of the former and on the sides of the latter: elytra rather strongly and closely punctured, and transversely confluently rugose: underside and legs brownish black, pubescent, punctured; antennæ (save the three basal joints) and palpi dusky brown.

Length 3 lines.

Hab. New Zealand. One example.

Techmessa telephoroides, n. sp.

Sublinear, depressed, slightly shining; somewhat thinly clothed with a short, subdecumbent, whitish pile: head and

prothorax brownish black; the front and hind margins of the latter reddish brown, rather coarsely and closely punctured and rugose; the punctures most crowded on the front and epistoma of the former, which are also unisulcate down the centre: prothorax distinctly wider than long, subcordiform, a little depressed and unequal by slight irregular depressions: elytra pale brown, with a yellowish tinge, closely punctured and rugose: underside reddish brown, pubescent, finely and not closely punctured; legs and palpi pale yellow; antennæ brown.

Length 3½ lines.

Hab. New Zealand. One example.

XV.—*Contributions to the Study of the Entomostraca.* By GEORGE STEWARDSON BRADY, C.M.Z.S., and DAVID ROBERTSON, F.G.S.

No. IX. *On Ostracoda taken amongst the Scilly Islands, and on the Anatomy of* Darwinella Stevensoni.

[Plates IV. & V.]

IN undertaking a dredging excursion to the Scilly Islands, concerning the marine fauna of which we were unable to obtain previously any very accurate information, we anticipated finding, at any rate in the more sheltered nooks of that archipelago, a field of exploration comparable in character and richness to many of the better-known hunting-grounds of the south and south-west of England. In this, however, we were disappointed. In no part did we find any great profusion of animal life, and on the whole the district impressed us as being the most barren and hopeless for the purpose of dredging of any which we have hitherto explored. Our stay at St. Mary's was cut short by the sudden advent of stormy weather; but we nevertheless obtained dredgings from many of the most promising spots in the neighbourhood of the principal islands; nor do we believe that a protracted visit would have materially altered the character of the result. We propose in this place to record the marine Ostracoda which occurred in the various dredgings; and we may also state that an examination of the fresh- and brackish-water ponds on the islands of St. Mary and Tresco did not afford any other than species commonly found in such localities in England.

The number of species of marine Ostracoda is sixty-seven, of which three (or four?) are new to science; but the general

aspect of the group is such as we should expect in any average British dredging. There is a distinct absence of the characteristic northern forms, and an almost equal want of such species as *Cythere emaciata*, *Bairdia acanthigera*, &c., which find their greatest development on the south coast. *Cythere lutea*, a common species of both the littoral and laminarian zones in most (and more especially in the northern) districts of Britain, is also wanting.

The following list embraces all the species found in our dredgings amongst the Scilly Islands, and in a littoral gathering of muddy sand from St. Mary's. The localities dredged were as follows:—off Porcressa Bay, St. Mary's, 20–30 fathoms, hard sand; S.W. off St. Agnes, 40 fathoms, hard sand, rock, and nullipore; inside St. Mary's and St. Agnes, 8–10 fathoms, hard sand; New Grimsby Harbour, 10–14 fathoms, muddy sand.

Pontocypris mytiloides (*Norman*).
—— trigonella, *G. O. Sars*.
Paracypris polita, *G. O. Sars*.
Cythere viridis, *Müller*.
—— albomaculata, *Baird*.
—— pellucida, *Baird*.
—— castanea, *G. O. Sars*.
—— porcellanea, *Brady*.
—— Macallana, *B. & R.*
—— badia, *Norman*.
—— crispata, *Brady*.
—— Robertsoni, *Brady*.
—— villosa (*G. O. Sars*).
—— convexa, *Baird*.
—— oblonga, *Brady*.
—— cuneiformis, *Brady*.
—— laticarina, *Brady*.
—— emaciata, *Brady*.
—— antiquata (*Baird*).
—— semipunctata, *Brady*.
Cytheridea cornea, *B. & R.*
—— elongata, *Brady*.
Eucythere Argus (*G. O. Sars*).
—— declivis (*Norman*).
Loxoconcha impressa (*Baird*).
—— granulata, *G. O. Sars*.
—— multifora (*Norman*).
—— tamarindus (*Jones*).
Xestoleberis depressa, *G. O. Sars*.
—— labiata, n. sp.
—— aurantia (*Baird*).
Cytherura nigrescens (*Baird*).
—— similis, *G. O. Sars*.
—— Sarsii, *Brady*.
—— fulva, n. sp.
Cytherura flavescens, *Brady*.
—— cornuta, *Brady*.
—— gibba (*Muller*).
—— cuneata, *Brady*.
—— striata, *G. O. Sars*.
—— angulata, *Brady*.
—— producta, *Brady*.
—— acuticostata, *G. O. Sars*.
—— cellulosa (*Norman*).
Pseudocythere caudata, *G. O. Sars*.
Cytheropteron nodosum, *Brady*.
—— subcircinatum, *G. O. Sars*.
—— latissimum (*Norman*).
—— n. sp.?
Bythocythere constricta, *G. O. Sars*.
—— turgida, *G. O. Sars*.
Cytherideis subulata, *Brady* (var. fasciata).
Sclerochilus contortus (*Norman*).
Paradoxostoma abbreviatum, *G. O. Sars*.
—— variabile (*Baird*).
—— ensiforme, *Brady*.
—— cuneatum, n. sp.
—— hibernicum, *Brady*.
—— Normani, *Brady*.
—— Fischeri, *G. O. Sars*.
—— arcuatum, *Brady*.
—— flexuosum, *Brady*.
—— obliquum, *G. O. Sars*.
Asterope Mariæ (*Baird*).
—— teres (*Norman*).
Philomedes interpuncta (*Baird*).
Polycope compressa, *B. & R.*

Xestoleberis labiata, n. sp. Pl. IV. figs. 8–15.

Carapace of the *female*, as seen from the side, oblong, subtriangular, highest near the middle; height equal to rather more than half the length: anterior extremity narrow, sharply rounded off; posterior wide, obtusely rounded: superior margin well arched; inferior nearly straight, but produced downwards towards the posterior extremity into a bulging prominence. Seen from above the outline is broadly ovate, tapering rapidly in front to an acute point, and very broadly rounded behind; greatest width equal to the height, and situated behind the middle. The shell of the *male* seen laterally is more slender, and less tumid behind; seen from above it is much more compressed and widest near the middle, the posterior extremity being somewhat narrowly rounded. The surface of the shell is smooth, distantly studded with small elevated round papillæ. The chief peculiarity of the species, however, is a remarkable labiate projection of the postero-inferior angle of the shell, which is more distinctly visible on the right valve (fig. 15). Length $\frac{1}{40}$ inch.

Xestoleberis labiata was dredged in New Grimsby Harbour on a bottom of muddy sand, in a depth of about 14 fathoms.

Cytherura fulva, n. sp. Pl. IV. figs. 1–5.

Carapace of the *female* very tumid; seen laterally subquadrate, broadly rounded in front, produced behind into an obscure rounded subcentral beak: superior margin evenly and very slightly rounded, sloping steeply backwards towards the posterior extremity; inferior nearly straight, sinuated in front of the middle: greatest height situated in the middle and equal to rather more than half the length. Seen from below the outline is very broadly ovate, widest in the middle, the width being somewhat greater than the height; anterior extremity broadly rounded, with a distinct central mucro, posterior also broad, but tapering to a subacuminate central point. Shell of the *male* seen laterally much more elongated, with nearly straight dorsal and ventral margins, the height equal to scarcely half the length; the outline as seen from below is also much more compressed. Surface of the shell obscurely reticulated and dotted, marked also, especially on the inferior surface, with faint longitudinal furrows. Length $\frac{1}{50}$ inch.

C. fulva was dredged pretty abundantly on a bottom of hard granitic sand, in a depth of 10–40 fathoms, off St. Mary's and St. Agnes.

Cytherura Sarsii, Brady. Pl. IV. figs. 6, 7.

We figure here what appears to be a local variety of this species, the outline being somewhat less angular than usual.

Cytherideis subulata, var. *fasciata*, nobis. Pl. V. figs. 1–5.

This differs from the typical form in having a conspicuous broad black band across the shell in front of the middle, and also in the reticulated structure of the shell, which is represented in fig. 5. The anterior margins of the valves (fig. 4) are crenulated.

Paradoxostoma cuneatum, n. sp. Pl. V. figs. 6, 7.

Carapace, seen laterally, oblong, subreniform, rather higher behind than in front; height equal to less than half the length; anterior extremity evenly, posterior obliquely, rounded; superior margin gently and evenly arched, inferior slightly sinuated in the middle. Seen from above, the outline is compressed, cuneate, greatest width near the posterior extremity and equal to one third of the length, tapering gently toward the anterior and abruptly toward the posterior extremity, both of which are subacuminate. Surface of the shell smooth. Length $\frac{1}{75}$ inch.

A few specimens of this species were dredged at New Grimsby Harbour and inside St. Mary's in depths of from 10–15 fathoms.

Note on the Anatomy of Darwinella * Stevensoni.

Our first description † of this curious Entomostracan being made from specimens which had been dried, and in which the contained animal could be very imperfectly seen, was incorrect in several important particulars. We propose now to rectify as far as we can our former errors, having, through the kindness of the Rev. J. Gunn of Norwich, been supplied with specimens of *Darwinella* in the fresh state. To that gentleman we wish here to express our cordial thanks for the assistance which he has both now and on other occasions given to us.

From the details of structure given below it will be seen that *Darwinella* occupies a position intermediate between the two families Cypridæ and Cytheridæ, though more nearly approaching the latter family. The points of divergence are

* Our first generic name *Polycheles* having been previously appropriated, was withdrawn in favour of *Darwinella* (see Ann. & Mag. Nat. Hist. ser. 4, vol. ix. p. 50, January 1872).

† Ann. & Mag. Nat. Hist. July 1870, p. 25.

found chiefly in the mouth-apparatus; but the lower antennæ also are abnormal, being quite destitute of the poison-gland and urticating setæ of the Cytheridæ. The mandible differs much in structure from any similar organ known to us in either family. The first pair of jaws presents no special peculiarity; but in the second pair (which in the Cytheridæ is converted, by the great development of the palp and atrophy of the jaw-apparatus, into a simple foot with a mere trace of its jaw origin in the form of a few bristles) we find a pediform palp extremely well developed, combined with a large jaw, which is armed with cutting-teeth and bears a fully developed branchial plate. The palp of the second jaw we described in our former paper as the "first foot;" the mandibles and first pair of jaws were also misunderstood, and indeed had not then been seen except very imperfectly. The following description gives, we believe, a true account of the structure of the animal:—

Antennæ very short and stout, strongly armed with curved claws and bristles: superior antennæ six-jointed, having all the joints as broad as or broader than long, and beset with short curved setæ; inferior four-jointed, of nearly equal thickness throughout: apex armed with four or five strong, slightly curved, claws; entirely destitute of poison-gland or urticating setæ, the place of which is occupied by a simple curved seta of moderate length. Mandible (Pl. V. fig. 8) broad, truncate at the free extremity, which is provided with six or seven small, slender, spiniform teeth; palp three-jointed, its basal joint very wide, beset with a series of nine curved setæ, and giving attachment to a small subcrescentic lamina which is fringed with about ten branchial filaments; second joint slender, nearly four times as long as broad, slightly curved and dilated at the distal extremity, where it bears one long and two small setæ; terminal joint more slender, about two thirds the length of the foregoing, and bearing at its truncate apex about six slender curved spines. Grasping portion of the first jaw (Pl. V. fig. 9) divided into four short setiferous segments, and bearing a very large oblong palp, which is fringed above with about twenty-four long branchial filaments, and has also four long deflexed setæ attached near its base. Second jaw (Pl. V. fig. 10) simple, short and wide, truncate at the apex, and divided into several slender curved spines, bearing a large three-jointed pediform palp and an ovate branchial appendage of moderate size. Two pairs of feet of moderate length, five-jointed; the second pair much the longest, and having the last joint armed with one long and two small curved setæ; first three joints of nearly equal length, fourth and fifth respectively

about one half and one third as long as the preceding. Abdomen ending in a short conical process. Copulative organs of the male of complex structure, the basal portion on each side consisting of a subrhomboidal acuminate lamina, the apical portion of an irregularly shaped plate produced laterally into an aliform process, and on the distal margin into a short strong hook. Female probably viviparous.

EXPLANATION OF THE PLATES.

Plate IV.

Fig. 1. *Cytherura fulva*, male, seen from right side.
Fig. 2. The same, male, seen from above.
Fig. 3. The same, male, seen from end. × 84.
Fig. 4. The same, female, seen from right side.
Fig. 5. The same, female, seen from below.
Fig. 6. *Cytherura Sarsii*, seen from right side. × 84.
Fig. 7. The same, seen from above.
Fig. 8. *Xestoleberis labiata*, female, seen from left side.
Fig. 9. The same, female, seen from above.
Fig. 10. The same, female, seen from below.
Fig. 11. The same, female, seen from end.
Fig. 12. The same, male, seen from left side. × 50.
Fig. 13. The same, male, seen from below.
Fig. 14. The same, left valve, seen from inside.
Fig. 15. The same, right valve, seen from inside.

Plate V.

Fig. 1. *Cytherideis subulata*, var., seen from right side.
Fig. 2. The same, var., seen from above. × 50.
Fig. 3. The same, var., seen from below.
Fig. 4. The same, anterior margin of shell. × 84.
Fig. 5. The same, shell-structure. × 100.
Fig. 6. *Paradoxostoma cuneatum*, seen from right side. × 50.
Fig. 7. The same, seen from below.
Fig. 8. *Darwinella Stevensoni*, mandible and palp: *a*, mandible; *b*, palp; *c*, branchial plate.
Fig. 9. The same, first jaw: *a*, incisive lobes; *b*, branchial plate. × 220.
Fig. 10. The same, second jaw: *a*, maxilla; *b*, pediform palp; *c*, branchial plate.

XVI.—*On the Generic Affinities of the New-England Chitons.* By Philip P. Carpenter, of Montreal*.

It has been common, with conchologists even of the "advanced" school, to call every mollusk with eight valves a *Chiton*, except the vermiform species, which Lamarck sepa-

* Communicated by the Author, having been read at the Meeting of the American Association for the Advancement of Science, held at Portland, August 1873.

rated as *Chitonellus*. The consequence has been that very little is known of most Chitonidæ except the external characters—the differentiation shown in the soft parts, and even in the shelly valves, having been overlooked.

We have been fortunate, during the explorations of the U. S. Fish Commission, in observing four species alive; another was taken alive at Eastport last year; a sixth has been captured on the southern coast. These are all as yet known to inhabit the American Atlantic seas from Labrador to Florida. A seventh, called *Chiton cinereus*, is said to have been taken alive by Dr. Pickering, and to be in the collection of the Philadelphia Academy of Natural Sciences; but it may prove to belong to one of the other species, or to be a ballast specimen.

The six authentic species present well-marked characters, ranging under five genera.

It may be premised that the Lamarckian genus *Chiton* was first divided by the Rev. L. Guilding according to the external characters of the West-Indian species. About the same time the Rev. T. Lowe published the peculiarities in the insertion-plates of the British species. Both papers appeared in the 'Zoological Journal.' Dr. Gray, however, was the first to present, in the 'Proc. Zool. Soc.,' a full description of the forms of Chitonidæ, accurately arranged under genera and sections, partly according to the external, but principally according to the internal characters. Mr. Henry Adams, in compiling the 'Genera' from H. Cuming's collection, was not allowed to examine the insertion-plates. He thought he saw, however, a correlation between the internal and external marks, and accordingly redescribed Gray's genera, with lists of species, according to the surface-diagnosis. Gray, in his 'Guide,' unfortunately copied from H. Adams's lists without examination. Lastly, Chenu, as usual, reproduced the mistakes of H. Adams, with fresh ones of his own.

Having had unusual opportunities of dissecting out the valves of Chitons, I have felt compelled to rectify the previously published lists, and also to propose various new genera. These I communicated to Mr. Binney while his edition of Dr. Gould's 'Invertebrata' was passing through the press; but he did not think well to alter the position of every one of our species, as I feel compelled to do.

1. The *Chiton apiculatus* does not appear in H. Adams or Gray. It is a true *Chætopleura*, distinguished by the thin hairy girdle, regular valves with sharp teeth, and long series of gills. I have not seen it alive. It ranges from Southern Massachusetts to Florida. The genus is for the most part tropical.

2. The *Chiton ruber* is *Leptochiton ruber* of H. Adams, and is probably *Callochiton puniceus*, Couth., of the same author. It is the *Tonicia rubra* of Gray's 'Guide,' to which he adds as synonyms, in P. Z. S., *marmorea* and *fulminata*; and it also appears in Gray's 'Guide' as *Corephium? rubrum.* It has not the characters of any one of these *four* genera, in which our two best authors have placed it. It belongs to Gray's genus *Ischnochiton* (=*Lepidopleurus*, H. Ad., not Risso), section †, "mantle-scales minute, granular;" but as the gill-rows are short, instead of surrounding the foot as in the typical species, it is necessary to establish a fresh genus, *Trachydermon.* The insertion-plates are, as in *Ischnochiton* and *Chætopleura*, regularly slit and sharp all round. Mr. Emerton first observed a great peculiarity in the animal, that there is a cancellated space between the posterior gill and the caudal extremity. Prof. Verrill observed that in different specimens there were either one, two, or three rows of holes on each side. The caudal lobe is generally figured as an anal tube; but in *T. rubrum* it is an imperforate muscle, working the posterior part of the girdle. The fæces were distinctly seen to escape, sometimes on one side, sometimes on the other, as it appeared to me from a slit on each side.

3. The *Chiton albus* is *Leptochiton albus* of H. Adams, = *sagrinatus*, Couth. I twice captured a live specimen; but each time it eluded the aftersearch. I do not doubt that this is also a *Trachydermon*, but cannot vouch for the peculiar characters above quoted. The genus belongs to cold and temperate seas.

4. The British *C. marginatus* is also a *Trachydermon*, and not a *Leptochiton.* It is the *C. cinereus* of Lowe, Forbes, and Hanley, but not of many other writers. Of the unique American shell so called I can say nothing.

5. The *C. marmoreus*, common at Eastport and northwards to Greenland, is *Tonicia* of H. Adams and Gray, simply because the girdle is smooth. The true southern *Toniciæ*, however, have pectinated insertion-plates and ambient gills, like the typical Chitons; while the northern species so called have sharp plates and short gills. They differ, in fact, from *Trachydermon* simply in the girdle being destitute of the minute scales. I distinguish the group as *Tonicella.*

6. The *C. mendicarius* does not appear in the lists, and is probably unknown in Europe. Fortunately a very few specimens were dredged in the 'Bluelight,' one of them smashed but very large. It is known outside by the minute bristles on the girdle; but within it presents the very abnormal characters which had before been observed only in the minute British

C. Hanleyi. This appeared as *Leptochiton Hanleyi* in Gray's first paper, but as *Acanthopleura Hanleyi* in his 'Guide,' p. 183. But in the same book, p. 186, the same species reappears as *Hanleya debilis*, the genus (constituted for that species alone) being said to have lateral tufts of spines; insertion-plates entire, of terminal valves alike. H. Adams, following this diagnosis externally, described other species which really had these spine-tufts though not the internal characters. However, on examining every specimen of the species in the market, I could not discern a single spine-tuft, though announced by the accurate Lovén. I found, however, excellent internal characters. All the valves were destitute of insertion-plates *except* the anterior one, which really *was* "entire," having one continuous plate, not slit. I did not know whether to believe my own eyes or the testimony of Lovén and Gray, till Prof. Verrill allowed me to open the large, smashed specimen of *C. mendicarius*. It proved to be a true *Hanleia*, according to my diagnosis, but not according to Lovén and Gray. I presume that the contraction of the skin in so minute a shell led to the *appearance* of tufts, and that Dr. Gray *supposed* that the posterior valve had an entire plate like the anterior. I should be glad of the opinion of the Section whether the genus *Hanleia* should follow the type against the diagnosis, as here given, or an unreal diagnosis against the type, as followed (in part *only*) by H. Adams. The animal of this species resembles *Leptochiton* in having short posterior gills, and a central anal tube from which the fæces were seen to exude.

7. A similar confusion attends the last and most remarkable species, *C. Emersonii*. Several live specimens were dredged by the 'Bluelight,' one of extraordinary size; and still more have been dredged by Principal Dawson at Murray Bay. For the original species *C. vestitus*, from Alaska, a genus *Amicula* was constituted by Gray, characterized by covered valves and regular pore-tufts. The elder Sowerby figured the *Emersonii* as *vestitus* in his 'Conch. Illustr.'; hence Dr. Gould naturally looked for the pore-tufts, and found them. Having received a fresh specimen from Dr. Stimpson, I could *not* find them. I wrote to Dr. Gould, who sent me his type specimens, with sketch of regular pore-tufts, as he saw them; but still I could not. He died without clearing the difficulty; and I presumed there might be two species, one with and one without pores. But after examining both northern and southern suites of specimens, I feel confidence in stating that there are no true pores, but simply a profusion of hair branches, generally very irregular, but sometimes, in early stages, more conspicuous at the

sutures. I propose, therefore, to keep the name *Amicula* for the Alaskan pore-bearing species—and to name this (with the Alaskan *Pallasii*) *Stimpsoniella*, in honour of one of the best naturalists born in New England. In this genus, as in *Trachydermon*, the fæces are expelled through slits close to the caudal lobe, one on each side. When at rest, the creature makes a posterior fold in the girdle, corresponding to the wave in the posterior valve.

I should be extremely indebted to any gentlemen who would lend me unusual Chitons for examination, previously to the publication of my 'Contributions towards a Monograph of the Chitonidæ' by the Smithsonian Institute. There is also a great field open for investigation to all those who can examine living Chitons or even dissect alcoholic specimens. It is known that the external characters are *not* coordinate with the internal ones; it remains to be found out whether either of them correlate with the anatomical characters of dentition, gills, vent, &c., which ought to furnish the best divisions in arranging this difficult group.

XVII.—*Descriptions of two new Species of Birds.* By ARTHUR, Viscount WALDEN, P.Z.S., F.R.S., &c.

Pelargopsis gigantea, n. sp.

Head, nape, chin, cheeks, back and sides of the neck, flanks, under tail-coverts, and entire under surface white, washed more or less with dilute fulvous, the concealed parts of the feathers being pure white and their exposed parts being tinged with fulvous; this hue is deepest on the flanks, breast, and on the abdominal and ventral regions, and on the under tail-coverts; crown nearly pure white; middle and lower part of the back rich pale glistening turquoise-blue; outer edges of primaries and secondaries, and all the tertiaries and scapulars, dingy bluish green; middle pair of rectrices above entirely, and lateral pairs on their outer webs, of a purer blue; under wing-coverts and axillaries fulvous, somewhat deeper than that of the flanks; bill coral-red; feet red.

Bill from forehead 3·25 inches, wing 6·62, tail 4·50, tarsus 0·88, middle toe 1·50.

Obtained at Salok, Sulu Islands, near Borneo, by Dr. Bernhard Meyer.

Scops modestus, n. sp.

Stiff loral bristles pure white at base, some tipped with

fulvous, some with dark brown or black; those of the chin pale fulvous, nearly white; over each eye a distinct broad whitish band, formed by pure white feathers narrowly tipped with yellowish brown, which again in most is narrowly fringed with black, some nearest the eyes also edged throughout their length with yellowish brown; feathers of the head and nape pale yellowish rusty, each traversed by three or four narrow irregular light brown lines; interscapulars and feathers of the back and rump coloured and marked like the plumage of the head and nape, but the brown transverse bands are broader and fewer; scapulars the same, but a few more or less pure white, mottled towards the tip with the prevailing tints; ear-coverts and cheeks principally white, with brown and ruddy fulvous markings; throat-feathers albescent, with one or more narrow brown cross bands; a half-collar below the throat of feathers marked and coloured like those of the nape; breast-feathers tipped with brown, a subterminal band of pale fulvous, then a brown band followed by a much broader pure white band; abdominal feathers white, tipped with an irregular ocellated mark centred with pale rusty fulvous and encircled with brown, then a broad white band with a basal and narrower brown band; in many of the abdominal feathers the ocellated markings are replaced by an irregular cross band of mixed fulvous and brown; under tail-coverts white, with faint subterminal fulvous-brown bands; tarsus clothed with white feathers, faintly barred with pale brown; ground-colour of the primaries and secondaries brown, each quill traversed by three or more pale rufo-fulvous narrow bands more or less complete, the brown intervals towards the apices of the primaries and on their outer webs much freckled with rufo-fulvous; on the outer web of the second, third, and fourth primaries the pale rufo-fulvous bands change to fulvous white or pure white; under wing-coverts greyish white; median rectrices marked and coloured like the apices of the primaries, lateral with clear rufo-fulvous bands running through, all tipped, like the median shoulder-edge, white. Tarsi feathered to within an eighth of an inch of the base of the toes; fourth and fifth quills equal, third slightly longer than sixth.

Wing 4·75 inches, tail 2·37, tarsus 1·0, middle toe with nail 1·12, bill from nostril (in a straight line) 0·65.

Two examples of this small plain-coloured Scops Owl were obtained near Port Blair, South Andaman, by Captain R. Wimberley.

XVIII.—*Notes on Norwegian Hydroida from Deep Water.* By the Rev. Thomas Hincks, B.A., F.R.S.

A paper of remarkable interest has just been published by G. Ossian Sars on the deep-water Hydroida of the Norwegian seas *. The investigations of this excellent observer, who worthily carries on the work of his distinguished father, have established the fact that a very varied Hydroid fauna exists in this region at depths varying from 50 fathoms to 300 fathoms. It comprises no less than fifty-eight species, of which sixteen appear to be new to science. From the tables (showing the distribution of the Norwegian Hydroids both vertically and horizontally) which are appended to the descriptive portion of the paper it appears that the most productive region lies between 50 and 100 fathoms. In this zone about two thirds of the whole number of species recorded for Norway have occurred (fifty-four out of eighty-four).

The littoral region, as might be expected, is barren, yielding only six forms—a striking contrast to the corresponding zone on our own shores, which teems with Hydroid life. The Laminarian is hardly more fruitful, giving eleven, of which two are common to it and the preceding. From 10 to 20 fathoms thirteen species have been obtained, from 20 to 50 (the "Coralline region") forty-two. Below 100 fathoms the numbers diminish with the increase of depth; from 300 fathoms only five species have been procured (*Plumularia gracillima*, n. sp., *Filellum serpens*, *Lafoëina tenuis*, *Campanularia verticillata*, and *Perigonimus abyssi*, n. sp.). The last of these alone passes the 300-fathom limit, and actually reaches 400.

If we except the fragments of a supposed Hydroid, brought up by the dredge of the 'Porcupine' from a depth of 2435 fathoms, of which nothing definite is known, the extreme vertical limit of Hydroid distribution would seem to lie between 600 and 700 fathoms, *so far as our present knowledge goes.* And it must be remarked that below *three hundred* fathoms a very small number only of forms have been obtained, a few straggling outliers, several of which seem to be much more at home in more moderate depths. In no sense can the Hydroida be considered an abyssal tribe.

In the chapter on "Distribution in Space" in Allman's 'Monograph of the Tubularian Hydroids' he places the maximum of development in the Coralline zone; but on the Norwegian coast it must be assigned to the "deep-water region" immediately succeeding it, which yields fifty-four species

* Bidrag til Kundskaben om Norges Hydroider. Af G. O. Sars. Med 4 autographiske Plancher. 1873.

against forty-two in the former. And the character of this "deep-water" fauna is as remarkable as its richness. It includes no less than thirteen of the sixteen undescribed species obtained by Sars, and (probably) three new generic types.

It is interesting to note the extended vertical range which these investigations have established for several well-known species. Thus *Tubularia indivisa*, which is common between tide-marks on the English coast, has been taken up at a depth of 200 fathoms; *Plumularia setacea*, a common denizen of our rock-pools, occurs only between 50 and 100 fathoms in the Norwegian seas; *Myriothela*, which is found near low-water mark, ranges to 100 fathoms; *Podocoryne carnea* is obtained on the shore and from 200 fathoms, and *Hydractinia echinata* at low-water mark and from 100 fathoms. It is also worthy of remark that Sars has obtained from a depth of 400 fathoms a Hydroid which he refers to *Perigonimus*, an Athecate genus, producing free reproductive zooids. In all previous cases the species dredged from great depths have been such as are propagated by means of fixed sporosacs and not by planoblasts *.

Passing to the descriptive portion of the paper, the first point of special interest is the occurrence of a small group of Plumularian Hydroids belonging to the genus *Aglaophenia*. This form is specially characteristic of warmer latitudes. On our own coasts it is comparatively rare in the north and north-eastern districts; in Shetland it is represented by a single species, *A. myriophyllum*. Still further north it has only occurred in the deep-water region, to which dredging has recently been extended. Near Stavanger, off the island of Hvitingsö, Sars has obtained three supposed new species of this fine genus, in depths varying from 80 to 150 fathoms. An examination of this group of southern strangers, thus encountered in the deep northern waters, discloses some points of interest. They were obtained on a muddy bottom at very considerable depths, and, we may therefore suppose, in one of the warm areas to which our attention has been drawn of late †.

The first species described (*Aglaophenia radioellata*) is

* *Vide* Allman's 'Monogr. Tubularian Hydroids,' part ii. p. 165. It is true that Sars did not actually observe the planoblast of his *Perigonimus abyssi*; but he had the opportunity of examining the gonophores, and had no doubt of the Medusan nature of their contents.

† This is a mere conjecture, as we have no *precise* account of the nature of the ground; but the deep-water region off Hvitingsö appears to possess a rich and peculiar Hydroid fauna which suggests the inference that it enjoys a comparatively high temperature. Allman mentions a new Plumularian genus, which was obtained during the cruise of the 'Porcupine,' at a depth of 682 fathoms, in water where the temperature ranged from 30°·5 Fahr. to 29°·8 Fahr. ('Tubularian Hydroids,' pt. ii. p. 165).

closely allied to the well-known *A. myriophyllum* of our own coasts, upon which, indeed, it is a very slight variation. In the shape of the calycles and in the minute structure generally the two are almost identical. The differences lie chiefly in size and habit, the points most readily affected by change of external conditions. The northern form is dwarfish as compared with our own; it looks stunted, and wants the elegant plumose appearance so characteristic of the latter. The stem, too, is simple and slender, instead of being composed, as in the normal *A. myriophyllum*, of several tubes bound together. One other difference between the two exists: in *A. radicellata* a large number of long and much-branched fibres are given off from the base of the stem, which form a spreading root-like appendage; by this the zoophyte fixes itself in the muddy ground, from which it was obtained. This, however, it must be remembered, is only an exaggerated condition of a structure which exists in *A. myriophyllum*. The latter zoophyte rises from a tuft of tangled fibres, a mere means of attachment when it grows on solid substances, but which, we can readily suppose, might be developed into a root-like organ under other conditions of life. The *corbula* of *A. radicellata* seems to resemble that of *A. myriophyllum*. The similarity of the two forms in minute structure * is really very striking, and the differences between them are just those which a change of locality might most readily produce.

The second species described by Sars (*A. bicuspis*) exhibits more distinctive characteristics; but its calycles are clearly of the *myriophyllum* type. It is somewhat larger than the preceding, but does not exceed a couple of inches in height. The stem is compound towards the base; and the pinnulated portion is much larger than in *A. radicellata*. The calycles in shape and arrangement resemble those of the last-named species and of *A. myriophyllum*; but the minute crenulation of the rim is wanting, and the central tooth on the front margin, which in *A. radicellata* was truncate and slightly sinuated at the top, is here divided down the middle so as to form *two acuminate processes*, which have suggested the name of the species. But the most remarkable peculiarity of *A. bicuspis* is found in connexion with the gonosome. The reproductive

* Sars seems to consider that the margin of the calycles is *more distinctly* crenulated in the Norwegian than in the British form, but the difference, if there is any, is of the slightest. Both are crenulated; and the crenations are of precisely the same character. A difference, however, does exist in the character of the anterior tooth, which in *A. myriophyllum* is pointed, in the northern form truncate and slightly sinuated at the apex.

capsules, instead of being borne, as in *A. radicellata*, on a certain number of the pinnules which are modified in structure so as to constitute a protective case for them (the *corbula*), are ranged along one side of *the main stem*; the usual corbula is absent; but at the base of many of the pinnules a bifid or trifid process is developed, and these processes, ranged in a row on each side close to the stem, bend inwards towards one another and so form a kind of protective covering for the gonothecæ. This structure is unique amongst the known Plumulariidæ. The processes just described are furnished with many of the sarcothecæ (or nematophores) so characteristic of the Plumularian family, and closely resemble in structure the elements which compose the corbula. Indeed we may regard them as constituting a kind of corbula, which, however, is developed in the axis of the plume, corresponding with the altered position of the capsules, instead of laterally along the pinnule. *A. bicuspis* fixes itself upon sponges; and its fibrous base is merely a flattened disk for attachment.

In the third species (*A. integra*), which is of larger growth, of a graceful plumose shape, and occasionally branched, we have the very same type of calycle; but the tooth-like processes on the margin have disappeared as well as the crenulation, and the rim is now perfectly plain. The sarcothecæ are much the same as in the two preceding forms; the capsules are borne on the central stem, as in the last, but all traces of protective appendages are wanting. The gonosome exhibits the character which we find in *A. pennatula* and kindred species.

From this deep-water region, then, near Hvitingsö we have three species of *Aglaophenia* all referable to the *myriophyllum* type, which are distinguished by very slight differences in the minute structure of the trophosome, but exhibit three distinct modifications of the gonosome. In the one which comes nearest to *A. myriophyllum* we find the usual open *corbula*; in another, a set of appendages developed near the base of the pinnæ, constituting a kind of axial *corbula*; in the third we have the gonothecæ wholly unprotected, as amongst the Sertulariidæ, and borne on the main stem. The first of these modifications of the gonosome is characteristic of Kirchenpauer's subgenus *Lytocarpia*, and the second, I believe, of Allman's genus *Gonocladium* (to be described in the report on the 'Porcupine' dredgings). If the genus *Aglaophenia* is to be dismembered, and the species composing it are to be distributed into groups distinguished by the character of the gonosome, I should propose the name Gymnangium for those with unprotected gonothecæ.

Sars has also added to the Norwegian list several species of

the genus *Plumularia*, and a very beautiful new generic form (*Polyplumaria*) allied to the latter.

Heteropyxis norvegica, n. sp.

Amongst the new Plumulariidæ we find a form which is referred to the *Heteropyxis* of Heller. I have given reasons elsewhere * for merging this genus in *Plumularia*; but I now find that I have misapprehended the characters on which it is based. In his brief generic diagnosis Heller makes no mention of the only peculiarity to which I should be at all disposed to attach any importance; and as I was unacquainted at the time with Meneghini's description of his *Lowenia* (which is identical with *Heteropyxis*), my decision was founded on an imperfect knowledge of the distinctive characters. The real peculiarity of the genus *Heteropyxis* is the subspiral arrangement of the pinnæ; in this it differs from *Plumularia* and makes an approach to *Antennularia*. The other characters are insignificant; but it may be convenient to retain the genus for those forms which, without being truly verticillate, have the pinnæ distributed round the stem. The curious point about *H. norvegica* is that it bears cornucopia-shaped capsules, exactly resembling those of *Plumularia cornu-copiæ* (mihi), a species from the Devonshire coast; the form is remarkable, and it is, as far as I can judge, absolutely identical in both. In *H. norvegica*, however, the position of the gonothecæ is peculiar: they are developed in pairs from a distinct process on the lowest joint of the pinna, a little above its point of origin.

Diphasia elegans, n. sp., and *Sertularia tenera*, n. sp.

These two new Sertularians were obtained from a bottom of soft mud or ooze, in depths ranging from 150 to 200 fathoms, and, we may therefore presume, in a comparatively warm area.

The *Diphasia* bears a strong general resemblance to *D. attenuata* (mihi). The chief points of difference seem to be the absence of joints on both stem and branches and of the tendril-like prolongations of the latter, the greater distance between the pairs of calycles, and the extraordinary development of the creeping stolon. The latter is the most marked character, and connects itself directly with the nature of the locality in which the species is found. A luxuriantly developed, much ramified, and sinuous fibre spreads over the muddy sea-bottom, through a great part of its length perfectly free, and only attached here and there to the small fragments of stone or shell sparingly

* "Notes on Prof. Heller's 'Catalogue of the Hydroida of the Adriatic'" (Ann. & Mag. Nat. Hist. ser. 4, vol. ix. p. 119).

scattered about in the neighbourhood. From this, at very considerable intervals, rise the slender plumose shoots.

The *Sertularia*, which is of a dwarf and meagre habit, is also distinguished by the largely developed stolon, which creeps unattached over the mud. It is interesting to remark the modification of this portion of the structure in conformity with the nature of the base on which the zoophyte grows. One of the *Aglaophenia* and two of the *Sertulariæ* obtained by Sars from great depths have thus adapted themselves to the peculiar conditions of ooze life.

Ophiodes parasitica, G. O. Sars (n. sp.).

Perhaps the most interesting of the many interesting forms for a knowledge of which we are indebted to the energetic researches of the Norwegian naturalist, is the remarkable Hydroid which he has named *Ophiodes parasitica*. In general appearance and structure it closely resembles a *Plumularia*, and might pass on a slight inspection for a stemless variety of one of the smaller kinds. But, instead of the ordinary sarcothecæ characteristic of the Plumularian family, it is furnished with the curious snake-like appendages which distinguish the genus *Ophiodes* (mihi). Judging from Sars's description and figures, there is no appreciable difference between these organs as they occur in the Norwegian species and on the British *Ophiodes mirabilis*. In each case they consist of a slender and highly extensile tentaculoid body, protected at the base by a small chitinous cup, and terminated at the free extremity by a globose capitulum filled with thread-cells. In *O. parasitica* they are confined to the erect stems, and are not present, as in *O. mirabilis*, on the creeping stolon also; one of them is generally placed a short distance below the calycle; and sometimes there is another a little above it. But though there is this remarkable point of agreement between the Norwegian Hydroid and the British, they are plainly not referable to the same genus. The affinities of *O. parasitica* are with the Plumulariidæ; those of *O. mirabilis* are as clearly with the Haleciidæ. Probably the two families are closely related; in the forms now under consideration they seem to make a near approach to one another. *Ophiodes mirabilis* differs in some important particulars from the ordinary type of *Halecium*; and the points in which it thus differs approximate it to such a form as the *O. parasitica* of Sars. The large polypites, which cannot retract themselves within the calycle, are common to all the Halcciidæ and to the genus *Plumularia*; and we now know that organs akin to the sarcothecæ are found in both the families.

As a new genus must be constituted for the Norwegian Hydroid, I propose for it the name *Ophionema* *. It may be defined as follows:—

Suborder **THECAPHORA.**

Family **Plumulariidæ.**

OPHIONEMA, n. gen.

Generic character.—Shoots small, simple or slightly branched, jointed, not regularly pinnate or plumose, attached by a creeping stolon; hydrothecæ sessile, unilateral, cup-shaped; tentaculoid organs distributed singly on the shoots, extensile, filiform, terminating above in a globular capitulum filled with thread-cells, and protected at the base by a chitinous cup; gonothecæ of large size, borne singly near the base of the shoots; polypites not retractile within the calycles †.

Ophionema parasiticum, G. O. Sars (sp. unic.).

Halecium gorgonoide, G. O. Sars (n. sp.).

This is another of the specially interesting forms brought to light by the exploration of the deeper regions of the sea-bottom. In most of its characters it bears a perfect resemblance to the well-known *Halecium*; but it differs from s n being furnished with a peculiar tentaculoid organ, somewhat similar to that which occurs on *Ophiodes* and on the new genus *Ophionema*, which I have constituted in this paper. These curious appendages are minute offshoots from the cœnosarc, which pass outwards through a simple orifice in the polypary, and project beyond it as naked, extensile, tentaculoid processes of a somewhat clavate figure, terminating above in a rounded capitulum filled with thread-cells. They differ from the similar structure which occurs on *Ophiodes* in the total absence of the chitinous covering at the base, and in the less distinctly capitate form of the free extremity. These appendages are distributed in great numbers over the stem and branches; and one of them is almost always present in the immediate neighbourhood of the calycles.

There can be no doubt, I think, that they constitute a character of generic value, and that the present species must be detached from *Halecium*. I propose to name the new genus

* From ὄφις, a snake, and νῆμα, a tentacle.

† I have included in this diagnosis some *family* characters.

that must be formed for its reception *Hydrodendron*; it may be characterized as follows:—

Suborder **THECAPHORA.**

Family **Haleciidæ.**

Hydrodendron, n. gen.

Generic character.—Zoophyte plant-like, much branched, rooted by a creeping stolon; hydrothecæ biserial, tubular, jointed to a short lateral process from the stem; polypites very large, partially retractile; tentaculoid appendages minute, filiform, naked, terminating above in a subglobose capitulum filled with thread-cells, distributed over the stem and branches, one below each calycle; gonothecæ unknown.

Hydrodendron gorgonoide, G. O. Sars (sp. unic.).

The polypites of this interesting form are remarkably large, furnished with about twenty-four tentacles, and of a bright yellow colour. The compound stem is thick and rugged and irregularly branched, and when covered with its conspicuous coloured polypites, the species bears, as Sars has remarked, a striking resemblance to a *Gorgonia*. It is peculiarly tree-like in appearance, and fully entitled to the generic name which I have given it. It has many characteristic features; but of course its principal distinction is to be found in the curious appendages to which I have referred.

Lafoëa fruticosa, M. Sars.

Amongst the Lafoëidæ included in Sars's catalogue of Norwegian species is the *L. fruticosa*, M. Sars, which was described many years since by his father in his 'Zoologisk Reise i Lofoten og Finmarken.' This form I have identified with the *L. gracillima*, Alder*; and in doing so I had the concurrence of Mr. Alder himself, who believed that his species was identical with the Norwegian, and that his name must yield to the earlier designation conferred by Sars. Mr. G. O. Sars, however, thinks that I have decided wrongly; he figures what he supposes to be his father's species, and holds that it is certainly distinct from *L. gracillima*. In this, I have no doubt, he is right; I have as little doubt that his figure does not represent *L. fruticosa*, but another and very different species. It is, in fact, referable to the form which I have elsewhere described as *Lafoëa grandis*†.

* 'History of British Hydroid Zoophytes,' i. p. 202.

† *Vide* a paper in the present Number of the 'Annals' on Icelandic Hydroida (*infrà*, p. 148).

A reference to M. Sars's more detailed description of his *L. fruticosa*, in his paper "Bemærkninger over fire Norske Hydroider" (1862), will show that it is very different from the form which his son has now figured. The latter has a regular, campanulate calycle of considerable breadth; the calycle of the former is described as bearing a general resemblance to that of *L. dumosa*, and as being slightly bent, with the convex side of the curve turned upwards, or occasionally reversed. In short, it is represented as being *tubular* and *bent*, whereas the hydrotheca in G. O. Sars's figure is *campanulate* and *straight*. The only differences which Prof. Sars could detect between his species and Alder's were that in the latter the calycle was rather more slender than in the northern form, and the pedicle "loosely twisted" instead of being distinctly ringed. But Alder's *L. gracillima* has a long, narrow, tubular calycle, totally unlike that which the younger Sars has figured in his paper. I have, however, other and very conclusive evidence that the *L. fruticosa* is not what the last-named naturalist supposes it to be. Prof. Sars and Mr. Alder corresponded about their species and exchanged specimens; and I have in my possession a bottle sent me by the latter, and labelled by him, containing Norwegian examples of *L. fruticosa, which he had received from its discoverer.* From these specimens the figures (Plate VI. figs. 8–10) accompanying my paper on Icelandic Hydroids in the present number were drawn (with the *camera lucida*); beside them I have placed a pair of calycles (Plate VI. figs. 6, 7) from specimens of *L. gracillima* dredged at Oban. The close similarity between the two is at once apparent; the *form* may be said to be identical in both; and the only difference between them to which I should be disposed to attach the slightest significance is found in the character of the pedicle. In the British form it is merely *twisted* into two or three imperfect whorls; in the northern it is composed of three or four *rings*. Sometimes they are almost obsolete (Plate VI. figs. 9, 10); but traces of them may always be detected. I confess I cannot regard this trifling variation as a specific distinction, and must therefore continue to rank the *L. gracillima* of Alder as a synonym of the older *L. fruticosa* of Sars.

I may add that, in his account of the latter species, Prof. Sars has remarked on the thinness and delicacy of the material composing the calycles, and tells us that when dried they collapse and shrivel up. The same holds good of *L. gracillima*; but in the case of *Lafoëa grandis* (to which I refer G. O. Sars's figures) the walls of the hydrothecæ are of very stout material, and retain their form in dried specimens.

Calycella producta, G. O. Sars (n. sp.).

The species described under this name will probably prove to belong to the genus *Lovénella* (mihi). Its position cannot, of course, be absolutely determined until the history of its reproduction is known; but it closely resembles the *L. clausa* (Lovén), and is very unlike any known member of the genus *Calycella*. Its polypite too (so far as the figure affords the means of judging) is of a totally different type from that of *Calycella*; so that if the characters of its gonosome should separate it from *Lovénella*, it must still be referred to some other genus. *Lovénella* is propagated by means of medusiform planoblasts.

The present species differs from the British *L. clausa* principally in the comparative shortness of the conical operculum, and the absence of all annulation or crenation on the stem, except at the very base.

Lafoëina tenuis, M. Sars.

This remarkable Hydroid was first described by Prof. M. Sars in 1868*; but we have now a further account of it and an excellent figure from his son. Bearing a curiously close resemblance in its general character to *Cuspidella humilis* (mihi), it is distinguished from the latter form by the extraordinary appendages, allied in structure and function to the sarcothecæ of the Plumularians, with which it is furnished. These are distributed in great numbers along the creeping stolon, amongst the calycles; they consist of a filiform offshoot from the ectoderm, somewhat enlarged at the upper extremity and invested by a thin chitinous covering.

In the capitular portion are lodged a few large thread-cells; and immediately above it there is a circular orifice in the chitinous envelope, through which the long barbed threads are discharged. These appendages not unfrequently almost equal the calycles in height, and largely exceed them in number. They remind us of the tubular sarcothecæ of the genus *Aglaophenia*, though it does not appear that the sarcostyle has the power of emitting amœboid processes. They may be regarded as an intermediate form between the Plumularian sarcotheca and the tentaculoid organ of *Ophiodes* and *Ophionema*.

I have lately ascertained that specimens of a Hydroid from Shetland and from the Northumberland coast, which I formerly referred to *Cuspidella humilis*, really belong to the present

* "Fortsatte Bidr. til Kundskaben om Dyrelivets Udbredning i Havets Dybder," Vid. Selsk. Forh. f. 1868 (Christiania).

species, so that *Lafoëina tenuis* must take its place in our fauna. At the time I noticed the transparent clavate processes associated with the calycles, but supposed them to be some parasitic growth.

A question may arise whether *Cuspidella humilis* is a distinct form at all, or whether it has been founded on examples of *Lafoëina*. I have been able to settle this point conclusively by a reference to specimens of the former; and Sars, who is intimately acquainted with the latter Hydroid, includes *Cuspidella humilis* also in his list of Norwegian species, and therefore recognizes them as distinct.

I have carefully re-examined the other species of *Cuspidella* (*C. grandis* and *C. costata*), and find them to be undoubtedly destitute of the appendages.

Gonothyræa hyalina, Hincks.

This fine species I have referred provisionally to *Gonothyræa**, having only had the opportunity of examining immature gonophores on specimens preserved in spirit. Sars, however, has obtained it at Lofoten with fully developed gonophores exhibiting the characteristic structure of this genus, and has thus definitely settled its systematic position.

Acaulis primarius, Stimpson.

We have hitherto known this interesting Hydroid imperfectly, through the description of it given by Stimpson in his 'Marine Invertebrata of Grand Manan.' Sars, however, has obtained it in deep water (40–100 fathoms) off the Norwegian coast on muddy ground, and has thoroughly investigated its structure.

The two most important points which he has determined are the mode of its attachment and the history of its reproduction. Stimpson found his specimen floating in the open sea, and describes *Acaulis* as permanently free. It appears, however (as Allman had conjectured) that this is an error; the stalk-like portion of the body below the aboral wreath of tentacles is invested by an exceedingly thin hyaline skin, which passes far beyond its free conical extremity in the form of a perfectly transparent sheath, and towards the base is thickly covered with small grains of sand and fragments of mud. By means of this sheath the polypite no doubt roots itself in the sand or ooze, as *Corymorpha* seems to do by the help of a very similar structure. The reproductive bodies are simple fixed sporosacs, developed in great number immediately above the proximal

* History of Brit. Hydr. Zooph. i. 184, pl. xxxv. figs. 2, 2*a*.

tentacles and amongst the capitate arms which thickly cover the whole of the upper portion of the body. *Acaulis* is closely related to the Tubulariidæ (through *Corymorpha*) and the Pennariidæ, but seems entitled to stand as the type of a separate family. *Myriothela*, on the contrary, I should connect more immediately with the Corynidæ; and the present species, as Sars has suggested, may be regarded as an intermediate form between it and *Corymorpha.*

Myriothela phrygia, Fabricius.

The British species of the genus *Myriothela* has hitherto been identified with the *M. arctica*, M. Sars, and the earlier *Lucernaria phrygia* of Fabricius; and the specific name conferred by the latter author has taken its place in our nomenclature. It appears, however, according to Mr. G. O. Sars, that two distinct forms exist, both of which occur in the Norwegian waters, and that the one which has been observed on our coasts differs from that which Fabricius first discovered and Prof. M. Sars afterwards so well described. It becomes necessary, therefore, to revert to the earliest name conferred on the *British* species, which we owe to Vigurs (1849). It will stand hereafter as *M. Cocksii*, while the original species must retain the name of *phrygia.*

It is to be regretted that Sars has not given us a fuller description of the northern form, and indicated more precisely the points in which it differs from the British. He tells us generally that it is distinguished from it by its different mode of attachment, and that its gonophores are borne on more or less branched processes furnished with capitate tentacles, resembling those which are scattered over the body.

Syncoryne eximia, Allman.

To this species, an inhabitant of the Laminarian zone on our English coasts, Sars refers a *Syncoryne* taken at Bodö in 80–100 fathoms. Judging, however, from his brief account, his identification seems to me more than doubtful. He describes his species as having a peculiarly dark brown polypary, which is most obscurely ringed; the polypites have very few tentacles. *S. eximia*, on the contrary, has a transparent, light-coloured polypary, and its polypites are furnished with as many as from twenty to thirty tentacles. The annulation is very distinct so far as it goes, being confined, however, to the very base of the principal stems, and to certain portions of the branches. It will be found, I believe, that the Nor-

wegian deep-water *Syncoryne* is a different and probably a new species.

The following British Hydroids have their range of distribution extended to Norway as the result of the investigations recorded in this paper:—

Plumularia setacea, *Ellis.*	Calycella syringa, *Linn.*
Antennularia antennina, *Linn.*	Cuspidella humilis, *Hincks.*
Diphasia alata, *Hincks.*	Gonothyræa hyalina, *Hincks.*
—— tamarisca, *Linn.*	Campanularia Hincksii, *Alder.*
Sertularia Gayi, *Lamx.*	Tubularia simplex, *Alder.*
Halecium Beanii, *Johnst.*	Dicoryne conferta, *Alder.*
—— sessile, *Norman.*	Myriothela Cocksii, *Vigurs.*
Calycella fastigiata, *Alder.*	Hydractinia echinata, *Fleming.*

I cannot take leave of this important paper without congratulating its able author on his most interesting discoveries, and on the valuable contribution which he has made to the literature of the Hydroida.

XIX.—*On a new Species of Fruit-Pigeon from Northern Queensland.* By John Gould, F.R.S. &c.

This little pigeon, which I propose to call *Lamprotreron porphyrostictus*, is totally distinct from its ally, the *L. superbus*, from the same part of Australia. The most conspicuous character of this bird is the purplish-blue spot at the back of the head; hence its specific appellation *porphyrostictus*.

The throat is grey, and the abdomen crossed with two indistinct bars of yellowish white; this latter colour also pervades all the outer edges of the under tail-coverts; with the exception of the two middle ones, all the tail-feathers are obscurely tipped with greyish white; the secondaries and the larger wing-coverts are edged with yellow; feet bright orange; tarsi thickly clothed with green feathers; bill dark.

The young of the year, having nearly attained its full size, differs from the adult in the total absence of the purple spot at the back of the head, and in having the lesser and greater wing-coverts fringed with yellow.

Total length 7 inches, bill $\frac{3}{4}$, wing $4\frac{3}{4}$, tail $2\frac{3}{4}$, tarsi $\frac{5}{8}$.

The two specimens of this species I possess were obtained at Cape York; and I need scarcely say that before describing this bird I have compared it with all the species in our national collections, brought home by Mr. Wallace from the Papuan group of islands, and I find it quite distinct from each of them.

XX.—*Notes on some Fishes obtained at considerable Depths in the North Atlantic.* By Dr. ALBERT GÜNTHER, F.R.S.

PROFESSOR WYVILLE THOMSON, before his departure with the 'Challenger' expedition, kindly placed in my hands for examination some fishes which had been obtained at considerable depths during the cruise of H.M.S. 'Porcupine' in the year 1869. In the first instance they had been sent for determination to the late Mr. Couch of Polperro, who affixed labels with names to the bottles; but no descriptions of the species were published by him; so that I should have omitted to allude to his nomenclature (which cannot be adopted), if I had not been informed that the fishes were enumerated under those names in one of the 'Porcupine' reports.

Small as the collection is, it is of interest in two respects:—

1. Inasmuch as it offers additional evidence that fishes hitherto known from more southern latitudes occur in the North Atlantic at a moderate depth (of between 80 and 200 fathoms) *.

2. Inasmuch as the fishes from the depth indicated do not yet show the well-known characteristics of deep-sea fishes developed in any degree. Therefore fishes like *Plagyodus*, *Melanocetus*, *Saccopharynx*, *Regalecus*, *Chiasmodus*, &c. must inhabit a much deeper horizontal zone (from 300 to 800 fathoms), as, indeed, has been supposed and affirmed for many years.

The *first* bottle is marked "No. 17. (18. 6. 69). 54. 10 N. 10. 59 W. 183 fms., muddy sand." Mr. Couch intended to describe the specimen contained in it as "*Macrourus linearis*."

This fish, which is not in good condition, crabs having eaten holes into various parts of the body, proves to be *Gadiculus argenteus*, described by Guichenot in 'Explor. Algér., Poiss.' 1850, p. 101, pl. vi. fig. 2, from specimens obtained at Algiers. I am not aware that the species has been noticed since; and therefore it is a point of interest to meet with it again in the North Atlantic. There is nothing whatever to indicate an affinity to *Macrourus*; indeed *Gadiculus* proves to be a *Gadus* slightly modified for living at a greater depth. Even the vomerine teeth, by the alleged absence of which, according to Guichenot, the genus was technically distinguished from *Gadus*, are present; but the scales, which are deciduous, and lost in our specimen, are larger* than in the allied species of *Gadus*. The formula of the fin-rays is D. 9 or 10 | 13 | 18. A. 17 | 16. V. 6. The specimen is 5½ inches long.

* See Ann. & Mag. Nat. Hist. 1867, xx. p. 289.

A *second* bottle (labelled "H.M.S. 'Porcupine,' between Shetland and Faroe, 200 faths. 1869," and determined by Mr. Couch as "*Macrourus*, sp. n.") contains an example, about 10 inches long, of *Coryphænoides norvegicus*. It agrees very well with Sundevall's excellent description published in 1840, which I can supplement by giving the number of dorsal rays as about 190, the tail of the specimen being perfect. There are eight or nine series of scales between the first dorsal and lateral line—and not four or five, as stated in the diagnosis of the 'Catal. Fish.' iv. p. 396, in accordance with Gaimard's figure of this species. Another, smaller specimen of the same species was in the *third* bottle, and stated to be from a depth of 540 fathoms.

The writing on the label originally placed on the *third* bottle has entirely faded and is illegible; but we are informed by a second label in Mr. Couch's handwriting that the bottle contains a "*Kurtus* and *Macrourus*, both new. 1869. 540 fathoms." The latter specimen has been noticed above. The former, of course, is widely different from the Indian genus to which Mr. Couch referred it, and is, in fact, *Argyropelecus hemigymnus*, a species common in the Mediterranean and neighbouring parts of the Atlantic.

A small *fourth* bottle contains only one specimen; it is labelled, in Mr. Couch's handwriting, "*Ophidium*—eel-like, deep sea—1869. H.M.S. 'Porcupine.' 180 faths." This specimen is the young of *Anguilla Kieneri*, a species hitherto known from the Mediterranean only.

The *fifth* bottle (labelled "H.M.S. 'Porcupine.' Between Shetland and Faroe. 180 faths. 1869") contains four specimens, named by Mr. Couch

Macrourus linearis, C.,
Blennius fasciatus, C.,
Gobius Jeffreysii,
Callionymus sagitta, C.,

and which I have determined as

Motella macrophthalma, Gthr.,
Blenniops Ascanii, Walbaum,
Gobius Jeffreysii, Gthr.,
Liparis vulgaris, Flem.

It was evidently by a slip of the pen that Mr. Couch applied the name "*Macrourus linearis*" again to a very different fish, viz. *Motella macrophthalma*, a species which, together with *Gobius Jeffreysii*, was described and figured by me in this Journal, 1867, xx. p. 290.

XXI.—*On the Invertebrate Marine Fauna and Fishes of St. Andrews.* By W. C. M'Intosh, M.D. &c.

Introduction.

The beach at St. Andrews combines smooth sandy flats with tide-worn ridges of rocks which freely communicate with the German Ocean; and the proximity to rich coralline ground renders the products of its storms peculiarly varied. An unbroken surface of pure sand extends from the estuary of the Tay past that of the Eden to the north-western border of the city. From this point the rocks run eastward in parallel rows—narrow sandy flats intervening between some of the ridges, which, with one exception, are all covered at high water. Lines of rocks having a similar arrangement fringe the Castle and Pier to the east sands; then a coarse sandy and gravelly beach extends in a southerly direction about half a mile, after which the jagged rocky border passes round the eastern coast to the Frith of Forth.

The greater part of the sandy bay has a depth of less than 10 fathoms; for at this point the 20-fathom line bends outwards to the Bell rock. The whole region is thus comparatively shallow, and in contrast with that to the north of Arbroath Road, or with the Frith of Forth and the neighbouring coast on the south.

If the fine stretch of sand from the river Eden to the city (usually termed the West Sands in contradistinction to the East Sands) which extends to the harbour southward is only enlivened in summer by thousands of bleached heart urchins, broken shells, skeletons of plaice, frogfish, and haddock, or in autumn by the jellies of the medusæ, the storms of winter and spring wholly alter the aspect. Immense banks of seaweeds mingled with black fragments of wood, coal, and muddy matter cover the beach, which in many parts becomes brilliantly phosphorescent at night from the zoophytes and annelids on the blades of the tangles. Amidst this débris are vast numbers of sponges, zoophytes, shells, starfishes, annelids, crabs, and fishes which have been swept from their various habitats. All storms are not equally prolific; they also vary in regard to the abundance of the several groups—a feature probably due to the direction of the wind and the invasion of particular sites. The waste of marine life in such storms does not attract much notice; yet it is extraordinary and so constant that it may be regarded to some extent as a check upon its uninterrupted development. It is, however, to be remembered that even the autumnal ripple in the Outer Hebrides brings

countless swarms of *Salpæ*, *Velellæ*, *Medusæ*, and other forms to die on the beach.

The tidal rocks, again, which are mostly covered by seaweeds, present a varied and prolific site for many species. The rock-pools are both frequent and picturesque; and they possess many undisturbed stones, often of large size, the under surfaces of which are most favourable for the growth and shelter of numerous forms—though of course they cannot be compared in this respect with the littoral stones at Herm, which have a profusion of rare crabs, annelids, ormers and other mollusks, polyzoa, hydroids, and the yellow, red, purple, green, and white sponges. The soft sandstone and shale afford an ample field for the perforations of *Pholas crispata*, *Saxicava rugosa*, and *Leucodore ciliata*. The fissures and chinks of the rocks, moreover, as on almost every part of the British shores, give shelter to a large number, especially the annelids, which find in the muddy or sandy crevices a safe retreat for their soft bodies, slender tubes, or muddy tunnels, and opportunities for capturing sufficient food at the free margin of the rock or from the ingoing currents. It is chiefly in such localities that *Sipunculus Johnstoni* and swarms of *Leucodore* and *Nicomache* occur, while *Nereis cultrifera*, *Eulalia*, *Syllis*, and the nemerteans are also common. Occasionally an *Idotea* is met with; but the general absence of the isopods in these crevices distinguishes them from those in the gneiss of the south and west, as in the Channel Islands and the Outer Hebrides—and especially from the former by the absence of *Pilumnus hirtellus*, *Arca*, the *Sabellidæ*, the *Eunicidæ* and their allies. To these fissures certain boring annelids and *Saxicava* chiefly retreat when the rocks do not afford a suitable medium for their perforations—though at St. Andrews there is free scope in this respect, from the sandstones and shales so soft as to be pitted deeply by the common limpet to those nearly as dense as granite.

The sea-margin at St. Andrews, like other parts of the east coast of Scotland, presents decided differences when contrasted with the northern, southern, and western shores, though many forms are common to all. Thus the laminarian zone at St. Andrews is much less luxuriant than that of the Zetlandic waters with the fine forests of gigantic tangles, amidst which there is a galaxy of animal life. The vegetation of its littoral zone is surpassed by the rich Fuci of the tidal rocks and the trailing masses of *Chorda filum* on the surface of the sea immediately beyond low-water mark in the Outer Hebrides. Its marine forms are placed under very different circumstances from those in the quiet voes of West Shetland,

as at Cliff Sound and between the Burras, where the still sea-water is bridged by a single arch of a few feet. To represent the *Zostera*-fields of the west and south there are but a few *Confervæ*, *Ulvæ*, and *Porphyræ* attached to stones on the flat surfaces of the beach. The calcareous rocks of the south, and the multitudes of worm-eaten boulders scattered on many parts of the shore, as in the Isle of Wight, form likewise a boldly marked contrast.

Within reach of the modern tide, also, it is interesting to find the remains of oceanic animals long since extinct—to see *Actinia mesembryanthemum* attached to a mass of encrinite stalks, *Litorina rudis* in groups on *Lingula*-shale, and the white coils of *Spirorbis* incrusting a nodule containing a fossil fish. Yet these features do not appear much out of place near a city whose pier is to a considerable extent constructed of the fine old stones and ancient oak which once formed part of the splendid pile of its cathedral.

On the whole the zoological features of St. Andrews are northern.

Subkingdom *PROTOZOA*.

Class RHIZOPODA.

Order **Spongiadæ**.

The Sponges of St. Andrews are, perhaps, the least-investigated group, partly because a collection carefully made many years ago has been lost. In looking over those obtained since, Dr. Bowerbank has most kindly given his experienced aid in doubtful cases; and the description of the new species is solely his. The littoral forms are scattered in considerable profusion between tide-marks under ledges and stones, sometimes near high-water mark. Indeed, in the higher pools and tide-runs in the latter region they are often peculiarly luxuriant. The brightly coloured *Halisarca*, so abundant on the under surfaces of stones in the Hebrides, and the rarer botryoidal *Tethea* are unknown at St. Andrews, as are likewise the cup and turnip sponges of the Zetlandic seas. The greater luxuriance of the ubiquitous *Halichondria panicea* on the stems of the Laminariæ further characterizes the coast of the extreme west; and the decay of the seaweed often leaves tubes of sponge from a foot to eighteen inches in length. In like manner the greatly increased size of *Grantia ciliata*, the vast abundance of *Hymeniacidon celata*, its beautiful arborescent patterns in the tide-worn shells, and its perforations in the limestone rocks are diagnostic of the warmer waters of the southern coast.

The classification of Dr. Bowerbank in his valuable work published by the Ray Society has been that followed in the list.

Suborder I. Calcarea.

Grantia compressa, Fabr.; Bowerb. Brit. Spong. ii. p. 17.

Abundant on *Cynthia grossularia* under shelving rocks between tide-marks, and attached to the roots of Fuci and other seaweeds. It occasionally assumes an abnormal form, and has a broad attached surface under stones. Longest, 3 inches.

Grantia ciliata, Fabr.; Bowerb. vol. ii. p. 19.

Not unfrequent on laminarian roots cast on the west sands after storms, and growing near low-water mark at the East Rocks. The species somewhat resembles a grain of oat removed from its husk.

Leucosolenia botryoides, Ellis & Sol.; Bowerb. vol. ii. p. 28.

Abundant on the under surfaces of stones in tidal pools, especially if large and little-disturbed. It frequently accompanies *Grantia compressa*.

Leuconia nivea, Grant; Bowerb. vol. ii. p. 36.

Found abundantly in the deeper tidal pools, under large stones which have been long untouched. It covers spaces several inches square; and its margin is generally rounded and "finished" like the border of a lichen. Most of the specimens have their surfaces elevated into firm rugæ, resembling miniature mountain-ranges, some of the crests rising into flattened lobes ⅜ inch in height. There are at least two varieties of this sponge—the first of which, besides the equiangular triradiate spicula of the skeleton, the minute acerate ones of the interstitial and dermal membranes, and the unicurvo-cruciform, has many spined acuate spicula of considerable dimensions and others of the same size approaching the fusiformi-spinulate character. In the other variety the latter kinds are so little developed, if present, as not to be distinguished from the ordinary minute acerate forms. In both, almost all the latter are distinctly spined.

Suborder II. Silicea.

Hymeniacidon ficus, Esper; Bowerb. vol. ii. p. 206.

Occasionally from deep water, attached to dead shells. Clavate specimens frequently grow from the smaller end of *Dentalium entalis*. This species seems to frequent muddy ground.

Hymeniacidon celata, Grant; Bowerb. vol. ii. p. 212.

Abundant in shells from deep water, between the layers of which it tunnels its devious tracks. This is one of the main agents in causing the disintegration of dead shells.

Halichondria panicea, Pallas; Bowerb. vol. ii. p. 229.

Scarcely a stone can be lifted near low-water mark, amongst the rocks, but has a patch of this common sponge. Under the cavernous ledges overhanging rock-pools it spreads its structure over the dark red *Cynthia*, matting together seaweeds and corallines, and hanging in pendulous nodules on interwoven stalks of *Corallina officinalis* and Fuci. Near the Maiden Rock splendid specimens are found incrusting a square foot or two of rock in some of the quiet pools. It also abounds on the backs of crabs, such as *Hyas araneus* and *Inachus dorynchus*, covering the former so completely that it can scarcely be recognized except by its legs; and besides the prominent oscula of the sponge, on this complex back are gaps for *Balani*, shells, and seaweeds. On the carapace of the latter species it forms a thinner coating, but is likewise grouped in little nodules on the legs. A mass as large as a good-sized apple surrounds the stem of *Chalina oculata*; and it is a common envelopment of various stones, mollusks, seaweeds, and tangle-roots. The usual colours of the sponge are yellow, brown, purple, green, and grey. In the interstices of the masses thrown on shore at the West Sands are to be found multitudes of marine animals, besides incorporated shells; and the fine patches at the East Rocks are favourite feeding-grounds of *Doris tuberculata*. The forms of the spicula of this species are variable, some being much curved like a stretched bow, a few more or less inæquiacerate vermiculoid, besides, of course, the ordinary diagnostic spicula. The odour emitted on tearing it from the rock is characteristic, but causes no sneezing.

Halichondria, n. s.*

The following is Dr. Bowerbank's description:—"Sponge coating, thin. Surface smooth and even. Oscula more or less elevated, dispersed, margins thin. Pores inconspicuous. Dermal membrane aspiculous. Skeleton very irregular, rete mostly unispiculous, occasionally bi- or trispiculous; spicula acerate, short and stout. Interstitial membranes aspiculous.

"Colour in the dried state light nut-brown. Examined in the living and dried states.

"The nearest alliance with the known species of the first

* Dr. Bowerbank has courteously named this species *H. M'Intoshii*, Bowerb.

section of our British *Halichondriæ* is with *H. regularis*. The spicula of the two species are as nearly alike in size and proportions as possible; but this is their only approximation to each other. In their other characters they differ to a considerable extent. The colour of *H. regularis* in the dried state is milk-white; that of *H. M'Intoshii* is nut-brown. Another important difference is, that while the skeleton of *H. regularis* is remarkable for its symmetry, that of *H. M'Intoshii* is irregular to a very considerable degree."

This form is not uncommon on the under surface of stones in tide-runs and somewhat muddy pools not far from high-water mark at the East Rocks. Its greyish brown colour, smooth surface, and prominent, well-defined oscula distinguish it at first sight from its allies.

Halichondria incrustans, Esper; Bowerb. vol. ii. p. 249.

Occasionally found under stones near low-water mark, especially at the East Rocks. It forms a thickish crust; and the spicula very much resemble one of the knobbed walking-sticks which taper from above downwards.

Suborder III. KERATOSA.

Chalina oculata, Pallas; Bowerb. vol. ii. p. 361.

Thrown in great profusion on the West Sands after storms; and small specimens are also found under the ledges of rocks near low-water mark. The shape of the specimens varies much: some are flattened and much divided into branches of various sizes, either narrow or broad; others have their branches much matted together so as to form a connected and somewhat coarse "gorgonian" appearance, more or less separated at the tip. In some the branches arise mostly from one side of an unbroken prolongation of the sponge-tissue. One grows on a valve of *Mytilus modiolus*, and has a mass of *Halichondria panicea* round a branch at its base. Another envelops the stem and branches of *Delesseria sanguinea*, the leaves of which appear here and there from the centre of the sponge. Many are attached to small rolled stones. Those from the beach are loaded with sand, spines of the common and purple heart urchins, bristles of the sea-mouse; and many starfishes seek refuge in their interstices.

Chalina limbata, Bowerb.; vol. ii. p. 373.

Not uncommon on the under surfaces of stones in tidal pools, either coating the surface of the stone or attached to the stems of *Corallina officinalis*.

[To be continued.]

XXII.—On Deep-water Hydroida from Iceland. By the Rev. Thomas Hincks, B.A., F.R.S.

[Plates VI., VII., & VIII.]

Some years have elapsed since Mr. Busk placed in my hands a bottle containing some northern Hydroida and Polyzoa which had been obtained by Dr. Wallich. The contents have been long since partially examined, and some of the results have been already published; but no separate report upon them has appeared, and some new forms which they have yielded are still undescribed. I propose therefore in the present paper to deal with the Hydroid portion. The gathering, though a very small one, is characteristic and interesting. It was taken up from a depth of 100 fathoms off Reikiavig, Iceland, "amongst icebergs, grounded and drifting." The number of species observed is only seventeen; and of these a large proportion belong to the Campanularian group of the Lafoëidæ. The extreme north seems to be in a special manner the home of the minute forms composing this family. No less than twelve species have been obtained off the coast of Norway by Dr. M. Sars and his son G. Ossian Sars, whose name is so honourably connected with the early history of deep-sea dredging. To these must be added four more, which I have found amongst the Icelandic dredgings, raising the whole number of Lafoëidæ known to inhabit the northern seas to sixteen. The British species number eleven.

These Hydroids are mostly inhabitants of deep water; off the coasts of Norway many of them occur at depths of from 50 to 100 fathoms, others at depths of 150, 200, and 300 fathoms respectively. The Icelandic specimens, as I have mentioned, were taken up in 100 fathoms *. A few of the Norwegian species occur in shallower water, ranging from 20 to 50 fathoms; but they constitute a very small proportion of the whole number. Some have a wide bathymetrical range: thus *Lafoëa dumosa* occurs in the littoral or Laminarian region, and has been dredged in 145 fathoms; and *L. gracillima*, which I have obtained in great luxuriance at Oban in 15–20 fathoms, has occurred to G. O. Sars off the island of Hvitingsö in 150. *Filellum serpens*, the common parasite of some of the larger Sertularians in the "Coralline zone," ranges, according

* During the 'Porcupine' expedition a *Lafoea* was dredged up from a depth of 845 fathoms. It was obtained from the "cold area" between Shetland and the Faroe Islands, at a point where the temperature of the water varied from 30°·5 Fahr. to 29°·8 Fahr. (*vide* Allman's 'Tubularian Hydroids,' part ii. p. 165).

to the same excellent observer, to the great depth of 300 fathoms. On the whole, the Lafoëidæ may be regarded as a deep-water group, and as most richly developed in the northern seas, so far as our present knowledge goes.

In the Icelandic dredgings they occur in profusion, and most of them attain a remarkable size. In the present paper I shall describe a new species (*Lafoëa grandis*) which is a veritable giant amongst its pigmy kindred, its calycles being nearly three times as large as those of the well-known *L. dumosa.* The representatives of *Calycella syringa* are about twice as large as those which may be met with on our own coasts. *Calycella pygmæa* * as found amongst the icebergs has almost ceased to deserve its name. I may also mention that Labrador specimens of *Lafoëa pocillum* are about twice the size of others obtained at Oban. And the larger growth is not confined to the Lafoëidæ; a gigantic variety of *Sertularella polyzonias* is also present, the calycles of which are very nearly three times as ample as those of the normal form, while the whole habit is singularly robust. *Sertularella tricuspidata*, a distinctly northern form and the principal element of the Icelandic dredgings, exhibits the greatest luxuriance and beauty, and bears in amazing profusion the reproductive capsules, which frequently line the branches throughout their whole extent.

What may be the cause of this unusual development I cannot pretend, with my present information, to decide; but he fact is undoubted.

The following is a list of the species:—

Subkingdom *CŒLENTERATA.*

Class HYDROZOA.

Order HYDROIDA.

Suborder **THECAPHORA.**

Family **Campanulariidæ.**

Campanularia volubilis, Linn.

Abundant on *Sertularia* &c. With capsules.

* In my 'History of the British Hydroid Zoophytes' I have ranked this species doubtfully amongst the unoperculated forms which constitute the genus *Lafoëa*. But I have ascertained that it is in fact provided with an operculum; and it must therefore be transferred to the genus *Calycella*.

Family **Lafoëidæ.**

Lafoëa grandis, n. sp. Pl. VI. figs. 1, 2.

Lafoëa fruticosa, G. O. Sars, Bidr. till Kundskaben om Norges Hydroider, p. 26, pl. iv. figs. 16–18.

Stem erect, compound, much and irregularly branched. *Hydrothecæ* large, campanulate, with a plain circular margin, borne on ringed pedicels (about three rings), and somewhat spirally disposed. *Gonothecæ* unknown.

The calycles of this handsome species are distinguished from those of all the other members of the genus by their size and campanulate form. As I have already mentioned, they are about three times as large as those of *L. dumosa*, and are raised on a well-developed pedicel with three or four strongly marked annulations. Instead of being tubular, they are of a tall bell-shaped figure, expanding slightly towards the orifice. They occur in pairs, which spring alternately from different aspects of the stem, and assume therefore a somewhat spiral arrangement.

Though very abundant, *L. grandis* only occurs in fragments amongst the Icelandic dredgings; but Sars's figure* shows that it attains a luxuriant shrubby growth, rising to a height of about an inch and a half.

Lafoëa fruticosa, M. Sars. Pl. VI. figs. 6–10, and Pl. VII. fig. 16.

Campanularia gracillima, Alder.

I have given my reasons elsewhere for identifying the *L. fruticosa* of Sars with Alder's *C. gracillima*, notwithstanding the opposite decision of G. O. Sars †. In one of the plates which accompany this paper I have given figures, carefully drawn with the *camera lucida*, of the Norwegian and the British forms for comparison. Both the variety with a *twisted* pedicle, described by Alder as *C. gracillima*, and the normal *L. fruticosa* occur amongst the Icelandic dredgings.

Calycella syringa, Linn.

Abundant on other zoophytes.

The calycles about double the size they attain in British examples. The gonothecæ are borne plentifully on the Icelandic specimens, and on others which I have received from Labrador. They are comparatively rare on our coasts.

Lofoten, from 60–80 fathoms, and more commonly from

* Bidrag till Kundskaben om Norges Hydroider, pl. iv. fig. 16.

† *Vide* a paper on new Norwegian Hydroida from deep water in the present Number of the 'Annals' (*suprà*, p. 132).

20–30 fathoms. "On the stems of *Eudendrium capillare*, Alder, which is often almost covered with its little transparent calycles and reproductive capsules, as with a fine down" (G. O. Sars).

Calycella pygmæa, Alder. Pl. VII. fig. 15.

On other Hydroids.

Calycella obliqua, n. sp. Pl. VI. figs. 4, 5.

Stem erect, simple, rooted by a filiform stolon. *Hydrothecæ* alternate, elongate, tubular (height more than four times as great as the breadth), gracefully curved, the convex side uppermost, obliquely truncate above, furnished with an internal membranous operculum, and borne on short ringed pedicels. *Gonothecæ* unknown.

This very distinct and elegant form is at once distinguishable from all its kindred by its obliquely truncate hydrothecæ. The wall of the calycle on one side for a short distance below the margin seems to be simply membranous, and to fold inwards slantwise across the tube, so as to form a kind of internal operculum.

Several specimens have occurred growing on other zoophytes.

Calycella quadridentata, n. sp. Pl. VIII. figs. 17–20.

Hydrothecæ cylindrical, usually slightly incurved on one side, the height about three times as great as the breadth, with a quadridentate margin and an operculum composed of four pieces, borne on ringed pedicels of variable length (3–7 rings), which rise at intervals from a creeping stem. *Gonothecæ* unknown.

This species, which bears a general resemblance to *C. syringa*, is at once known by the quadridentate rim of the calycles and the quadripartite operculum. The denticles on the margin are well marked; and the operculum is composed of four broad and short segments, corresponding with the spaces between them; whereas in *C. syringa* it is made up of as many as eight or nine rather narrow and elongate pieces, forming a somewhat elevated cone (Pl. VIII. fig. 24). The calycles are of the same general shape in the two species; but the outline is stiffer and less wavy in *C. syringa* than in the present form. The pedicel of *C. quadridentata* is rather thicker than that of its ally, and is usually, as far as I have observed, short (3 or 4 rings), though sometimes the number rises as high as seven.

This elegant form is not uncommon amongst the Icelandic dredgings, creeping over other Hydroids.

Cuspidella humilis, Hincks.

Creeping over the stems of *Halecium crenulatum*.

Lafoëina tenuis, M. Sars.

This remarkable Hydroid, first described by the elder Sars, and figured by his son in his recent paper on Norwegian Hydroida, occurs amongst the Icelandic dredgings, creeping over other zoophytes. The species may readily be mistaken for the *Cuspidella humilis* (mihi), from which it is chiefly distinguished by the very remarkable sarcothecæ with which it is furnished. In preserved specimens these may be easily overlooked.

Filellum serpens, Hassall.

Creeping over the stem of other zoophytes. It has a wide distribution on the Norwegian coasts, and occurs at great depths as well as in shallower water.

Lofoten, from 300 fathoms (*G. O. Sars*).

Family **Haleciidæ**.

Halecium muricatum, Ellis and Solander.

A few fragments with reproductive capsules.

This species has been found off the coast of Labrador.

Halecium crenulatum, n. sp. Pl. VIII. figs. 21–23.

Stem compound, branched; branches straight, regularly crenulated above each joint. *Hydrothecæ* supported on very short lateral processes, single or in pairs, alternate, elongate, expanding gradually towards the margin, which is slightly everted, twisted at the base, bearing a strongly annulated branchlet given off from the side. *Gonothecæ* ovate, shortly stalked, springing singly or in pairs from the lateral process beneath the calycle.

The above diagnosis is of necessity defective; for though many fragments of the species occur amongst the Icelandic dredgings, I have not met with a specimen in a perfect condition, nor even with a piece of any considerable size. From an examination of the fragments, I am able to say that in its mature state it possesses a compound stem; but of the *habit* I can give no account; the portions from which my description is chiefly taken are either detached branches or imperfectly developed shoots. The minute characters, however, are suffi-

ciently marked, and I have no doubt that the species is distinct from any hitherto described. It makes the nearest approach to *H. labrosum*, Alder; but its calycles are very different from those of the latter species. They are not annulated towards the base, nor have they the much everted rim so characteristic of *H. labrosum*. The lower portion, supporting the cup in which the base of the polypite is lodged*, is perfectly plain, or exhibits only a slight twist near the point of origin. The whole hydrotheca is trumpet-shaped, expanding gradually upwards towards the margin, which is but slightly everted. From the lower part, a little beneath the cup, a short, strongly annulated branchlet is given off. Frequently the primary calycle supports a second, as is commonly the case in this genus, which rises from within it.

The stem is very regularly and distinctly crenulated above each joint; and this is a marked character, giving a very elegant appearance to the species. On the portions which I have had the opportunity of examining there were sometimes short branchlets alternating with the calycles, and exhibiting the same structure as the larger stems. The lateral processes supporting the calycles are very short. The gonothecæ are ovate, membranous, borne on a short stalk which is not ringed, and are developed on the lateral process. The stems are of a dark horn-colour.

Family **Sertulariidæ.**

Sertularia tenera, G. O. Sars.

One or two specimens occur of this interesting form, which has recently been obtained at great depths (150 fathoms) off the coast of Norway by G. O. Sars.

Sertularella tricuspidata, Alder.

Very abundant and fine.

Sertularella polyzonias, Linn. Pl. VII. figs. 11, 12.

Abundant.

The robust habit and gigantic calycles give a very marked character to the species. So distinctive is its appearance that, while there are no differences entitling it to specific rank, it is worthy of being recorded as *S. polyzonias*, var. *gigantea*. Sars mentions a robust variety

* The polypites of *Halecium* are only partially retractile; and little more than the base of the body is contained in the cup-like chamber which forms the upper portion of the hydrotheca. The lower portion is tubular, and in the present case almost plain throughout, whereas in *H. labrosum* it is strongly annulated near the base.

of this species which he had obtained from Greenland and Massachusetts; it may very probably be identical with the Icelandic form. Packard also tells us that in the Straits of Belle Isle (Labrador), *S. polyzonias* is found "very stout and large" in the deeper water.

Sertularella geniculata, n. sp. Pl. VII. figs. 13, 14.

Stems slender, decidedly geniculate, simple or slightly branched, jointed and twisted above each calycle; the internodes long, attenuated below, and bent in opposite directions. *Hydrothecæ* very distant, ribbed transversely, chiefly on the upper half, rather broad below, and narrowing gradually towards the aperture, which bears four very prominent teeth, is sinuated deeply between them, and is surmounted by a conical quadripartite operculum. *Gonothecæ* unknown.

Height (of the largest specimen met with) about $\frac{1}{3}$ inch.

This is a critical species. In general character it closely resembles *S. tenella*, Alder; but, after careful examination, I feel little doubt that it is a distinct form. The stem is zigzagged; the internodes, which bend in opposite directions, are so much attenuated below as to have the appearance of distinct pieces jointed together rather than of the segments of a continuous stem. They are longer than those of *S. tenella*, and rather less decidedly twisted or annulated at the base. The calycles are about half as large again as those of the allied species; they want the regular barrel-shape of the latter, are not rounded off below, but broad and squarish, and do not taper off so decidedly towards the upper extremity. They want altogether the constriction immediately below the aperture, which, to a greater or less extent, is found in *S. tenella*. The teeth are very large, prominent, and acuminate, and the margin is deeply sinuated between them; while in the last-named species they are comparatively inconspicuous, and the rim is very slightly depressed between them. The aperture is "conspicuously squared" in *S. tenella*, and the operculum *rises but little above it*; in *S. geniculata* the operculum is prominently conical. The transverse ribs are much less pronounced, not giving the sharply crenulated appearance to the sides which they do in *S. tenella*; and they extend generally over a smaller proportion of the calycle. The contour and "set" of the hydrothecæ are very different in the two forms, though it is very difficult to give an exact idea of the difference in a description. The sides are rounded or curved outwards in *S. tenella*, almost straight in *S. geniculata*.

To sum up, the former species has neat, rounded, barrel-

shaped, strongly ribbed calycles, narrowed very decidedly towards the somewhat overhanging rim, which bears four short teeth, and is very little depressed between them; the latter has large, straight-walled, somewhat broad-based calycles, not sharply carinated transversely, narrowing very gradually towards the margin, which bears four very prominent and pointed teeth, and is deeply sinuated between them.

The ramification of *G. geniculata* is peculiar. Branches are given off rarely at right angles to the stem, springing from the base of a calycle; sometimes two branches are developed at opposite points on the same internode. Not unfrequently the internodes comprising a shoot do not all lie in the same plane; on the lower portion the calycles face one way and a different way above.

Notwithstanding the similarity in some points to *S. tenella*, I believe the present to be a well-established form, which may properly be ranked as a species.

Amongst the Icelandic dredgings *S. geniculata* is not uncommon.

Sertularella tenella, Alder.

I have also met with a characteristic specimen of this species.

EXPLANATION OF THE PLATES.

Plate VI.

Fig. 1. *Lafoea grandis*, Hincks, magnified.
Fig. 2. The same, more highly magnified.
Fig. 3. *Lafoea dumosa*, Fleming, drawn to the same scale as the preceding, to show the comparative size.
Fig. 4. *Calycella obliqua*, Hincks, highly magnified.
Fig. 5. The upper portion of a calycle, to show the structure of the orifice.
Figs. 6, 7. *Lafoea fruticosa*, M. Sars, var. *gracillima*, highly magnified. Drawn from Oban specimens.
Figs. 8, 9, 10. *Lafoea fruticosa*, M. Sars, highly magnified. Drawn from Norwegian specimens communicated by Prof. Sars.

Plate VII.

Fig. 11. *Sertularella polyzonias*, Linnæus, var. *gigantea*, magnified.
Fig. 12. The same, of the ordinary size. Drawn to the same scale for comparison.
Figs. 13, 14. *Sertularella geniculata*, Hincks, magnified.
Fig. 15. *Calycella pygmæa*, Alder, highly magnified.
Fig. 16. *Lafoea fruticosa*, M. Sars, a slender variety from Shetland, highly magnified.

Plate VIII.

Figs. 17–20. *Calycella quadridentata*, Hincks, magnified in different degrees.
Figs. 21–23. *Halecium crenulatum*, Hincks, magnified
Fig. 24. *Calycella syringa*, Linn., highly magnified.

XXIII.—*Third Notice of a Collection of Fishes made by Mr. Swinhoe in China.* By Dr. Albert Günther, F.R.S.

In the two previous communications on Mr. Swinhoe's collections of Chinese fishes published in this Journal for 1873 (Sept. pp. 239–250, and Nov. pp. 377–380) the majority of species enumerated were from Shanghai, and only eleven from the more northern Chefoo. A case just received from this indefatigable zoologist contained collections made exclusively in the latter locality, adding much to our knowledge of its fauna. The species of fishes collected by Mr. Swinhoe at Chefoo amount now to forty-seven.

12. *Mustelus manazo*, Schleg.

13. *Triacis semifasciata*, Girard.

14. *Raja porosa*, sp. n.

Allied to *Raja marginata*. The anterior part of the snout is abruptly contracted into a narrow thin appendage; the width of the interorbital space is more than one third of the distance of the eye from the end of the snout. Anterior profile undulated. Teeth in fifty-four or fifty-six series in the upper jaw, pointed in the male, flat in the female (as in the majority of the species of *Raja*). Superciliary margin with a series of spines; rostral process with small stellate asperities; a series of three or four spines in the median line of the back behind the head; tail with three series of spines in the male and with five in the female. The width of the disk is much more than the distance from the end of the snout to the hind margin of the ventral fin. Upper parts brown, with the snout white; lower parts whitish, tinged with brown. The skin of the lower part of the snout and of the throat is perforated with numerous large pores, white in the centre and surrounded by a black ring.

The male is provided with a band of hooks near the angle of the pectoral fin and again on each side of the head, and the anterior margin of the disk is covered with asperities on its upperside in its whole length. The female is smooth on the parts just mentioned, but provided with a broad band of small hooks along the upperside of the posterior margin.

Two specimens, male and female, adult, 11 inches broad.

15. *Trygon*, sp., young.

16. *Hapalogenys nigripinnis* (Schleg.).

17. *Pagrus major*, Rich.

18. *Chrysophrys Swinhonis*, sp. n.

D. $\frac{11}{11}$. A. $\frac{3}{8}$. L. lat. 55. L. transv. $6\frac{1}{2}/15$.

The height of the body is contained twice and two fifths in the total length (without caudal), the length of the head thrice and one fifth. Eye rather small, one half of the length of the snout, more than one half of the width of the interorbital space (which is convex), and equal to the height of the suborbital. Suborbital not quite twice as long as high. Cheek with seven series of scales. A very slight protuberance above the upper anterior angle of the eye. Molar teeth in four series above, and in three below. Dorsal spines very strong; the fourth, fifth, sixth, and seventh of nearly equal length, and half as long as the head. The second anal spine very strong, stronger, but not longer, than the dorsal spines. Caudal fin but slightly emarginate. Pectoral fin extending to the anal. Silvery; a spot at the commencement of the lateral line, the operculum, a broad margin of the vertical fins, and the membrane of the ventral fins black.

The largest of four specimens is 14 inches long.

19. *Pelor japonicum*, C. & V.

20. *Seriola Lalandii*, C. & V.

21. *Caranx atropus*, Bl. Schn.

22. *Echeneis naucrates*, L.

23. *Sciæna Dussumieri*, C. & V.

24. *Otolithus aureus*, Richards. Ichth. Chin. p. 224.

D. 9 | $\frac{1}{28}$. A. 2/7. L. lat. 86.

The height of the body is contained four times and a half in the total length (without caudal), the length of the head thrice and three fourths. There are nine scales in a transverse row between the anterior dorsal spine and the lateral line. Snout obtusely conical, not much longer than the eye, with the upper jaw slightly overlapping the lower. Cleft of the mouth wide, the maxillary extending beyond the hind margin of the orbit. Eye large, its horizontal diameter being equal to one fifth of the length of the head and to the width of the interorbital space, which is somewhat convex. Canine teeth of the upper jaw rather small. Dorsal spines rather strong, the fourth being the longest and two fifths of the length of the head. Anal spine very feeble. Silvery, with bronze-

colour tinges; hinder and upper part of the axil of the pectoral fins black.

One specimen, 22½ inches long.

25. *Platycephalus japonicus*, Tiles.

26. *Platycephalus cultellatus*, Richardson, Ichth. Chin. p. 217.

D. 1 | 7 | 13. A. 13. L. lat. 160.

The length of the head is contained thrice and two fifths in the total length (without caudal); the distance between the eyes is more than one half of the length of the snout. The upper surface of the head is quite flat, the ridges being scarcely prominent. Præopercular spines strong, the upper shorter than the lower. Lateral line smooth. Grey; all the upper parts, paired fins, and dorsal rays densely dotted and punctulated with brown. Caudal fin with two oblique black bands above, with one below, and one straight band along the middle.

One specimen, 15 inches long. A second, smaller specimen was obtained at Shanghai.

This species is closely allied to *P. insidiator*, from which it will be readily distinguished by its much smaller scales. The figure on which Richardson founded this species is very rudely executed, and the ridges are represented in the form of thorns; however, the coloration shows that the artist has had before him the same species from which my notes are taken.

27. *Trigla kumu*, Less.

28. *Chirus hexagrammus*, Pall.

29. *Agrammus Schlegelii*, Gthr.

30. *Gobius hasta*, Schleg.

31. *Triænophorichthys trigonocephalus*, Gill.

This species has the chest scaly. A fresh specimen from Chefoo shows the following coloration: it is dark brown, with an indistinct black longitudinal band along the middle of the side; the lower part of the head, the dorsal fins, and the caudal are punctulated or finely marbled with blackish and white.

32. *Triænophorichthys tæniatus*, sp. n.

D. 6 | 12–13. A. 12. L. lat. 60.

About eighteen longitudinal series of scales between the second dorsal fin and the anal. The height of the body is

two ninths of the total length (without caudal), the length of the head two sevenths. Head broader than high, flat above. The width between the orbits is less than the diameter of the eye, which is one fifth of the length of the head. Snout as long as the eye, obtuse, with the cleft of the mouth horizontal, the upper jaw being slightly longer than the lower; the maxillary extends slightly beyond the anterior margin of the orbit. *The entire head and the chest before the ventrals naked.* Scales ctenoid. Dorsal fins nearly equally high, lower than the body; caudal obtusely rounded; the ventrals terminate at a great distance from the vent. Greyish yellow, with two brown longitudinal bands on each side—the upper starting from the superciliary margin and running along the base of the dorsal fins to the upper caudal rays, the lower from the lower part of the eye across the upper portion of the axil and along the middle of the side of the body.

Two specimens, the larger of which is 3 inches long.

33. *Sphyræna pinguis*, sp. n.

D. 5 | $\frac{1}{9}$. A. 10. L. lat. 95.

The height of the body is contained seven times in the total length (without caudal), the length of the head thrice and one fourth. Eye large, its diameter being two elevenths of the length of the head and one half of the postorbital portion. Maxillary terminating at some distance in front of the orbit. Mandible without lobe in front, armed with seven larger teeth on each side, the smaller teeth not included. Interorbital space rather convex, narrower than the orbit. Præoperculum with the angle produced into a rounded lobe. The origin of the first dorsal fin corresponds to the extremity of the pectoral, and is behind the root of the ventral fin. The distance between the first and second dorsals is less than twice the length of the latter. Above greenish, beneath silvery. Fins light-coloured.

This species has a remarkably round body. Two specimens, 14 inches long.

34. *Mugil soiuy*, Basil.

35. *Ditrema Temminckii*, Blkr.

36. *Pleuronectes asperrimus*, Schleg.

37. *Pleuronectes variegatus*, Schleg.

38. *Synaptura zebra*, Bl.

39. *Exocœtus brachycephalus*, Gthr.

40. *Belone anastomella*, C. & V.

41. *Saurida tumbil*, Bl.

42. *Engraulis encrasicholus*, L.

The common anchovy of Europe.

43. *Engraulis chefuensis*, sp. n.

D. 13–14. A. 31. L. lat. 35.

Allied to *Engraulis rhinorhynchus*.

The height of the body equals the length of the head, and *is one fourth of the total* (without caudal). Snout much pointed, and much projecting beyond the lower jaw. Teeth present in both jaws, minute. Maxillary somewhat dilated above the mandibulary joint, tapering behind, not reaching the gill-opening. Gill-rakers fine, closely set, as long as the eye. Origin of the dorsal fin rather nearer to the end of the snout than to the root of the caudal fin. Anal fin commencing at a short distance behind the last dorsal rays. Abdomen compressed, the spiny scutes extending forwards to the gill-opening. A blackish spot across the neck.

Several specimens, 5 inches long.

44. *Pellona elongata*, Benn.

45. *Chatoëssus punctatus*, Schleg.

46. *Murænesox cinereus*, Forsk.

47. *Monacanthus septentrionalis*, sp. n.

D. 38–39. A. 34–35.

Skin rough, velvety. The height of the body is one half of the total length (without caudal). Pectoral fin opposite to the hind margin of the orbit, immediately behind the base of the dorsal spine. Snout with the upper profile scarcely convex. Dorsal spine two thirds or three fourths as long as the head, compressed and armed with a single lateral series of small barbs; side of the tail without any armature. Dorsal and anal fins low. Ventral spine fixed. Uniform brownish grey. Caudal blackish, with the interradial membrane whitish, and without any cross bands.

Two specimens, 11 inches long.

There is a small specimen 4½ inches long in the collection, which I believe to be the young of this species, but which differs in a remarkable manner by having the dorsal spine subtetrahedral, a row of barbs running along each edge.

The anterior barbs are much smaller and much closer together than the posterior. The upper half of the body shows two or three irregular longitudinal bands.

I may add here that Mr. Swinhoe has quite recently obtained at Shanghai specimens of *Carcharias lamia* (Risso), a species hitherto believed to be limited to the Atlantic, and of a sturgeon which appears to be the

Acipenser Dabryanus.

Acipenser Dabryanus, Duméril, Nouv. Arch. Mus. iv. p. 98, pl. 22. fig. 1.

One specimen, 31 inches long. The numbers of shields differ a little from those given by Duméril. Dorsal 12; lateral 34 or 37; ventral 11; D. 51.

XXIV.—*On the Dwarf Buffalo of Pennant.* By Sir VICTOR BROOKE, Bart., F.Z.S.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,

With reference to Dr. Gray's remarks upon my paper on "African Buffaloes" in the December number of your Journal (p. 499), I would merely ask any person interested in the matter to turn to Pennant's 'Synopsis of Quadrupeds' and to judge for himself as to the correctness of Dr. Gray's statements. Pennant, in his description of the "Dwarf" (p. 9), thus writes, "*The horns of this animal are in the Museum of the Royal Society, described by Grew, page* 26," and upon plate 8. figure 3 he figures these horns.

Turton, having founded the name *Bos pumilus* upon Pennant's "Dwarf," it follows that the horns spoken of and figured by Pennant are typical specimens of "*Bos pumilus.*"

In the British Museum are a pair of horns, entered in the 'Hand-list of Edentate, Thick-skinned, and Ruminant Mammals' (1873, p. 82) *as received from the Museum of the Royal Society*, which exactly agree with Pennant's description and figure. There can therefore, I think, be no reasonable doubt that they are the identical specimens figured and described by Pennant.

These horns are likewise the type of Blyth's *Bubalus reclinis*.

It is therefore clear that if I am right in considering *Bubalus reclinis* to be the male of *Bos brachyceros*, both these names must give way to the older name of *pumilus*.

With regard to Dr. Gray's general remarks on the character of my work and the accuracy of my synonyms, I do not care to reply to them, but leave future workers to judge between us.

Your obedient Servant,
VICTOR BROOKE.

Dec. 30, 1873.

XXV.—*Description of a new* Sibia *from the Nágá Hills, North-east Frontier, Bengal.* By Major H. H. GODWIN-AUSTEN, F.R.G.S., F.Z.S., &c., Deputy Superintendent, Topographical Survey of India.

THE bird now described as new was obtained during the cold season of 1872–73, when I was employed on the Boundary Survey of the Nágá Hills and Munipúr. Other species collected at the same time, and those lately described in a paper read before the Zoological Society, form part of a collection of birds I have been bringing together on the north-east frontier of India. Lists of these have been given from time to time in the 'Journal of the Asiatic Society of Bengal,' vol. xxxix. part 2, 1870, and vol. xli. part 2, 1872.

Sibia pulchella, nov. sp., Godwin-Austen.

Above ashy grey, bluer on the head, the two centre tail-feathers umber-brown, terminating (each colour ¾ inch) in rich black, followed sharply by dark grey. The outer tail-feathers are tipped in like manner with grey, but the black increases on each feather outwards, and on the last extends to its base. Shoulders of wing blue-grey, with a bar of pale chocolate-brown coming in at the base of the black primary and secondary coverts. Quills grey-black, the primaries edged pale hoary blue; the secondaries blue-grey, the last three are umber-brown, and the last two are edged narrowly on outer web with black. A narrow frontal band and lores black, extending both over and below the eye to base of the ear-coverts. Beneath ashy blue, with a vinous brown tinge upon the lower breast and abdomen. Bill black; legs horny brown; irides ——?

Length 9·5 inches; wing 4·1, tail 4·85, tarsus 1·3, bill at front 0·75.

I shot two specimens of this very beautifully but subdued-coloured *Sibia* in April last, when making the ascent of the peak of Khûnho, Eastern Burrail range, Nágá Hills, at about 8000 feet. The bird appeared pretty numerous, in companies of four to six or eight, haunting the tops of the rhododendron trees, then in full bloom, busily engaged searching for insects in the flowers, and their forehead, chin, and throat were covered thick with the pollen.

In the general distribution of the coloration and form it resembles *S. gracilis*, extremely common in the same locality, but seldom seen there above 6000 feet.

XXVI.—*On the Theory of the Process of Fermentation.* By Dr. H. Karsten.

Cagniard de Latour in 1836 recognized alcoholic fermentation as a physiological process dependent upon living creatures; and I subsequently (in the 'Bot. Zeitung' for 1848 and 1849) indicated the pathological nature of yeast, *i. e.* that the yeast-cells were not true species of plants, as was supposed by Latour (and by Persoon, 1822), but pathological organizations. This view is now, after long discussion, making some way, in opposition to the opinion maintained by the majority of chemists (following Liebig) that fermentation is a purely chemical process quite independent of any vital action.

Although in 1870 Liebig admitted that alcoholic fermentation is dependent on the presence of living yeast-cells, he endeavoured, nevertheless, to preserve his previous opinion to a certain extent, by assuming that it was the fluid contents of the yeast-cells which effected the decomposition of the sugar, &c.

In accordance with the processes of *decay* in which the *oxidation of the albuminous materials* transfers itself to the neighbouring carbon compounds (a view, the incorrectness of which I demonstrated in 'Poggendorff's Annalen,' 1860), the *process of fermentation* is supposed to be dependent upon the decomposition of albuminous unorganized substances (outside the cell according to Liebig's former opinion, but within it according to his present view), which then also seizes upon the surrounding molecules of complex carbon compounds.

But that even this last conception does not accord with the true nature of the process, and that the *products of fermentation were generated by the vegetating membrane* of the yeast-cell and not by its fluid contents, had already been demonstrated by me in my memoir on the Chemistry of the Vegetable Cell in 1869.

Probably Liebig would not have taken all these circuitous ways towards the natural explanation of the process of fermentation had he known that the yeast-cells, even though they do not increase (nay, perhaps may diminish) in weight, are yet constantly vitally active and engaged in continual new formation, and that during the growth of their membranes these finally become changed into vegetable acids, lactic acid, succinic acid*, and, if we may judge by the analogy of other processes, into glycerine, alcohol, carbonic acid, fat, &c.

Pasteur, who has so thoroughly studied the chemical products of alcoholic fermentation, and so greatly increased our knowledge of them, and to whom we are indebted for finally setting free his *confrères* from the long persistent error that fermentation is a purely chemical act—even Pasteur, in his fresh attempt to establish a theory of the process of fermentation ('Comptes Rendus,' 1872), struck upon the same rock, in thinking that the chemical processes of fermentation differ from a number of other phenomena, and especially from the actions of the other vital phenomena, by the circumstance that a much greater weight of the fermentescible substance is decomposed than the weight of the acting ferment amounts to. That this view is erroneous in every respect we see at once if we compare the quantity of nutriment of any animal with the weight of its body, and, on the other hand, consider the continual regeneration of the yeast-cells, which was urged against Liebig in my 'Beitrag zur Geschichte der Botanik' (1870).

Pasteur also believes that this fact of the inferiority of weight of the organized ferment is connected with its nourishment in the absence of free oxygen; and he finds in this the distinguishing characteristic of fermentation as compared with other vital processes. "Fermentation," says Pasteur, "is a special case of a very general phenomenon; nay, we might say that all creatures, under certain conditions, are ferments. If we kill any creature, or organ in any creature, or a group of cells in this organ, by suffocation, by cutting through nerves, &c., the physical and chemical life in them will not immediately cease, it will continue; and when this takes place under such conditions that free oxygen (interior or exterior) is wanting, then the organism, the organ, or the cells will necessarily derive the heat which they require for their processes of nourishment and growth from the substances surrounding them; they will consequently decompose these, and we shall see the peculiar character of fermentations appear, when the amount of heat developed represents the decomposition of a quantity of fer-

* 'Harz-, Alkohol- und Milchsäuregährung,' 1871, p. 70, from the 'Zeitschr. des œsterreich. Apotheke-Vereines,' 1870–71.

mentescible substances which is distinctly greater than the weight of the substance set in motion by the organism, the organ, or the cells."

Pasteur, who seems here to agree with my opinion (first expressed in the 'Botanische Zeitung' for 1848) as to the vitality and faculty of increase of cells (*e. g.* secretion-cells or *embryonal* tissue-cells) which have become diseased by abnormal conditions of nutrition, nevertheless, led astray by correctly observed but erroneously interpreted facts, mistakes the nature of a whole group of these pathologico-necrobiotic vital processes. The observation that beer-yeast growing upon the surface of a solution of sugar absorbs atmospheric oxygen, and converts it into carbonic acid without producing alcohol, whilst the same yeast when carried beneath the surface of the fluid by shaking produces alcohol as well as carbonic acid, has misled Pasteur to the assumption that oxygen regularly suppresses alcoholic fermentation.

Assuming that Pasteur's statement is correct, and that yeast floating on the surface of a solution of sugar produces no alcohol, this does not prove that oxygen in such small quantities as the fluid dissolves prevents the formation of alcohol, and that the submerged yeast does not come into contact with oxygen. As fermentation is due to continuous regeneration and increase of the yeast-cells, and for the production of cells oxygen must necessarily lend its aid unless all our observations are at fault, Pasteur's proposition that oxygen unconditionally prevents alcoholic fermentation must need modification as follows:—that the unobstructed action of the atmospheric oxygen upon yeast-cells prejudices their property of furnishing alcohol and carbonic acid as products of the assimilation of grape-sugar, inasmuch as it induces the cuticularization of the membrane of the yeast-cells (that is to say, its partial conversion into a resinous, fatty substance). It is well known that masses of yeast, after being dried in the air, furnish more alcohol on distillation than fresh undried yeast; and all sorts of daily experiences with saccharine fruits and solutions seem to stand in opposition to Pasteur's views.

Recently Pasteur has been confirmed in his opinion formed upon the observation of vegetating yeast by the analogous interpretation of a second fact, likewise correctly recognized.

Couverschel long ago (Poggend. Ann. xxii. 1831) observed that ripe saccharine fruits, when kept in carbonic acid, were apparently well preserved for a long time, but at last passed into alcoholic fermentation with indications of decay. Pasteur repeated this experiment, and found that plums, grapes, melons, all acid fruits and many others, when kept in

carbonic acid for a time, passed into a state of alcoholic fermentation, whilst they still appeared externally to be perfectly sound and well-preserved. From twenty-four plums which had lain for a few days in carbonic acid, and had almost improved in apparent soundness and firmness of flesh, he obtained 6·5 grms. of absolute alcohol. In this case also Pasteur derives the alcoholic fermentation from the absence of oxygen.

I also obtained an alcoholic distillate from grapes and plums under similar circumstances, not only when they were preserved in carbonic acid, but also in hydrogen or in an air-tight vessel in atmospheric air (in the latter case the oxygen was probably soon converted into carbonic acid by the ripe fruits). Although no trace of mould or other signs of the commencement of decay could be recognized, 36 cub. centim. of distillate contained 2·8 vol. per cent. of alcohol.

Moreover plums which had been kept for an equal time in *pure oxygen* (prepared by the ignition of chlorate of potash) *with hydrate of potash* also furnished an alcoholic distillate; nay, ripe figs which had lain in ozonized air showed signs of alcoholic fermentation by their odour and the commencement of yeast-formation in their cells. Under these circumstances also, just as when they had lain in carbonic acid and in hydrogen gas, the fruits retained their normal sound appearance for weeks, and were not attacked by mould, whilst other similar fruits lying in the air had long been decayed and mouldy. On those plums which, as described, had been preserved under pure oxygen gas, a partial production of mould had certainly commenced; but for the purpose of distillation twenty-four well-preserved fruits, of perfectly sound appearance, with no signs of mould, were selected. Some similar fruits were examined microscopically, and proved to be free from Fungi in the interior also.

Even in those experiments which furnished a distillate with a neutral reaction, alcohol was obtained, but 1 per cent. less than in those in which carbonic acid was employed. Other grapes and plums which were exposed to the atmosphere showed no trace of alcohol even when distilled over platinum-black.

Consequently the fruits which in other respects appeared sound, were affected and passed into alcoholic fermentation by excessive action of oxygen just as by other gases injurious to the normal assimilative activity, although (to judge from the results of distillation) this occurs rather later in oxygen gas than in the gases employed in the other experiments.

The exclusion of oxygen, therefore, is not the immediate cause of alcoholic fermentation and allied phenomena in the

organs and tissues fitted for them, but the *abnormal processes of development of the embryonal cells contained in the tissue-cells*, called forth by physico-chemical agencies, in the presence of sufficient quantities of grape-sugar or other bodies, corresponding with other processes of fermentation and decomposition. Alcoholic fermentation, therefore, like the other processes of fermentation and decomposition, has its foundation in the necrobiosis of the organs and tissues in question.

The fruits are suffocated in the oxygen gas, and in the other gases employed, just as they are killed in every pure gas, in water free from air, by mechanical injuries, &c.; the normal process of maturation is interrupted, in consequence of which, and the presence of sugar in their cell-fluid, the cellules contained in the latter or their endogenous new formations acquire the nature of yeast-cells. In figs and grapes this may be recognized* very easily even from the form of the yeast-cells thus produced; whilst in plums, as in the gooseberries which I employed formerly (see 'Botanische Zeitung,' 1848) in experiments on fermentation in hydrogen gas, the newly formed cells acquire a globular form.

Even here it is proved that the kind of biological process of the cell-generations which develop themselves within dying tissue-cells is dependent upon the chemical nature of the cell-fluid and the matter and forces acting from without. The *Vibrios* and *Bacteria* do not originate putrefaction, nor does yeast originate fermentation, but rather the forms which the cells acquire are determined by the nature of the nutritive material. If the fluids are predominantly albuminous, putrefaction ensues with *Bacteria* and *Vibrios*; if they are saccharine, fermentation takes place with yeast, as I have demonstrated in my 'Fäulniss und Ansteckung' (1872, p. 2). Nay, according to the different chemical nature of the fluids, variations of these processes will occur, presenting in their course the greatest similarity to the biological processes of normally assimilating secretion-cells. But in reality these morbidly developed cell-generations are completely different in their nature from the latter.

* In figs we may most easily convince ourselves of the production of yeast-cells within the tissue-cells during the sojourn of the fruit in carbonic acid, if we add to the microscopic section of such a fruit a portion of a solution of cane-sugar or sugar of milk, and then observe it for some time. This object may be cemented down like a microscopical preparation; and it then slowly but surely shows the growth of the yeast-cells. Figs which had lain for eight weeks in carbonic acid without showing any signs of mould or changing much in form and colour, but which had a vinous-acid odour, were especially fitted to exhibit this development of the grape-sugar yeast.

The secretion-cells are subjected to the creative activity of a composite organism, the preservation and regeneration of which they subserve; their task is synthesis. On the contrary it is the office of these ferments to decompose dead and dying organic substances into their simpler compounds, and to prepare them for decay; their task is analysis. To regard these ferment-cells (*Hysterophymata*) as equivalent to perfect organisms shows a complete misconception of their true nature.

Schaffhausen, November 1873.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

May 8, 1873.—Francis Sibson, M.D., Vice-President, in the Chair.

"Contributions to the Study of the Errant Annelides of the Older Palæozoic Rocks." By H. ALLEYNE NICHOLSON, M.D., D.Sc., M.A., Ph.D., F.R.S.E., Professor of Natural History in University College, Toronto.

In this communication the author endeavours to elucidate the abundant and obscure organic remains which are found so commonly in the Palæozoic rocks, and especially in the Silurian strata of Britain, and which are generally known by the vague and convenient names of "Fucoids," "Annelide-burrows," and "tracks." After expressing his opinion that the first step towards the study of these obscure fossils lies in the provisional grouping and naming of the more marked forms which are already known to exist, the author proceeds to divide the remains under consideration into two great groups. In the first of these groups are those fossils which are truly the *burrows* of marine worms, as distinguished from mere trails and surface-tracks. Some of these burrows (*Scolithus*) are more or less nearly vertical in direction as regards the strata in which they are found; and they are to be looked upon as being true burrows of habitation. In this section are placed the genera *Scolithus*, *Arenicolites*, and *Histioderma*. Other burrows are of a totally different nature from the preceding, and may reasonably be compared to the burrows of the recent lobworms. These burrows run more or less horizontally as compared with the laminæ of deposition, or they penetrate the strata obliquely. They are not burrows of habitation, but are wandering tunnels excavated by the worm in its search after food. The fossils of this group, therefore, as preserved to us, are not the actual burrows themselves, but the burrows filled up with the sand or mud which the worm has passed through its alimentary canal. The burrows of this kind (including many forms previously described under the names

of *Chondrites*, *Palæophycus*, &c.), the author groups together under the name of *Planolites*.

The second great group of Annelide-remains comprises genuine surface-trails or "tracks," which of necessity never pass below the surface of the bed on which they occur. Some of these remains, such as *Crossopodia*, are, beyond doubt, due to the operation of marine Annelides: but it may be a matter of question whether we have in these cases the actually petrified body of the worm, or merely the track produced by the passage of the animal over the surface of the mud or sand. The author, however, gives reasons for believing that the latter explanation is truly the correct one. Other fossils belonging to this group (such as *Myrianites*) are equally, beyond doubt, produced by the operations of marine animals; but it remains quite uncertain whether they have been formed by Annelides, Crustaceans, or Mollusks. Lastly, there are remains which appear to be really *casts* of the surface-trails of Annelides or other marine creatures, and which, therefore, are elevated above the surface of the bed on which they occur. Such remains may readily be confounded with those belonging to the genus *Planolites*, from which they are only distinguishable by the fact that they are strictly confined to a single surface of deposition. To fossils of this nature the author proposes to restrict the generic title of *Nemertites*.

Finally, the author describes some singular tracks apparently produced by Crustaceans belonging to the genus *Ceratiocaris*, and for which he proposes the generic name of *Caridolites*.

The following list comprises the species of fossils described in this communication:—

A. Burrows.

I. Genus Arenicolites, Salter.
1. Arenicolites sparsus, *Salter*.
2. —— didymus, *Salter*.
3. —— robustus, *Nicholson*.

II. Genus Scolithus, Haldeman.
4. Scolithus canadensis, *Billings*.
5. —— linearis, *Hall*.
6. —— verticalis, *Hall*.

III. Genus Histioderma, Kinahan.
7. Histioderma hibernicum, *Kinahan*.

IV. Genus Planolites, Nicholson.
8. Planolites vulgaris, *Nicholson*.
9. —— granosus, *Nicholson*.
10. —— articulatus, *Nicholson*.

B. Trails.

V. Genus Crossopodia, M'Coy.
11. Crossopodia scotica, *M'Coy*.
12. —— lata, *M'Coy*.

VI. Genus NEMERTITES, M'Leay.
13. Nemertites Ollivantii, *Murchison.*
14. —— (Palæochorda) major, *M'Coy.*
15. —— (Palæochorda) minor, *M'Coy.*

VII. Genus MYRIANITES, M'Leay.
16. Myrianites tenuis, *M'Coy.*
17. —— Murchisoni, *Emmons.*

C. APPENDIX.

VIII. Genus CARIDOLITES, Nicholson.
18. Caridolites Wilsoni, *Nicholson.*

June 19, 1873.—William Spottiswoode, M.A., Treasurer and Vice-President, in the Chair.

"Experiments on the Development of *Bacteria* in Organic Infusion." By C. C. PODE, M.B., Demonstrator to the Regius Professor of Medicine, and E. RAY LANKESTER, M.A., Fellow and Lecturer of Exeter College.

The following passage from Dr. Charlton Bastian's 'Beginnings of Life' (vol. i. p. 429) induced us to make experiments similar to those mentioned in it, with the view of testing the correctness of Dr. Bastian's conclusion as to matter of fact:—

"On the other hand, the labours of very many experimenters have now placed it beyond all question of doubt or cavil that living *Bacteria*, *Torulæ*, and other low forms of life will make their appearance and multiply within hermetically-sealed flasks (containing organic infusions) which had been previously heated to 212° F., even for one or two hours. This result is now so easily and surely obtainable, as to make it come within the domain of natural law." And in a note is added, "In a very large number of trials I have never had a single failure when an infusion of turnip has been employed; and from what I have more recently seen of the effects produced by the addition of a very minute fragment of cheese to such an infusion (see Appendix C, pp. xxxiv–xxxviii), I fully believe that in 999 cases out of 1000, if not in every case, a positive result could be obtained." Though this is one out of a great number of statements made by Dr. Bastian upon which he bases speculations as to the prevalence of spontaneous generation or archebiosis, we think it necessary to state that we have not considered that (which is a question of interpretation) as the point at issue, but merely the question of fact as to the appearance of *Bacteria* in what may be considered, according to our present lights, infusions duly guarded from inoculation. The point under discussion is one as to a fact in the natural history of *Bacteria*, in a further study of which we are occupied at the instance of the Radcliffe Trustees; and we believe that a more precise knowledge of the life-history, life-conditions, and

various forms of these organisms is necessary before the hypothesis of their spontaneous generation can serve as a safe guide in scientific investigation.

The experiments recorded below were made with infusion of hay and with infusion of turnip, sometimes with the addition of a few fragments of pounded cheese. It is necessary at once to call attention to three precautions which we have taken, and which we think are indispensable:—1. Recognizing the fact that the presence of lumps is a possible source of error, we excluded these from our infusion, either by filtration or by decantation. 2. To ensure the satisfactory exposure of the whole contents of the tube to the boiling temperature, we, as a rule, *completely* submerged our experimental tubes in boiling water for a period varying from five minutes to half an hour. 3. The substances used in preparing the infusions being necessarily of a very heterogeneous nature, we always examined samples of the infusions before and after boiling, at the time of closing the tubes, and were thus able to determine whether any *change* had taken place in the visible particles contained in the fluid after a lapse of time.

The microscopes used by us throughout, working side by side with samples from the same infusion, were a Hartnack's Stative VIII. objective No. 10 à immersion, ocular 4, belonging to the anatomical department of the University Museum, and a large Powell and Lealand belonging to the Radcliffe Trustees, which is provided with a $\frac{1}{12}$ and a $\frac{1}{50}$ objective. The former of the two English glasses was more usually employed than the latter, on account of its greater convenience in manipulation.

Appearances in freshly prepared infusions.—Since the objects seen in such infusions are remarkable, and have doubtless sometimes led to error in subsequent examination of infusions, we may draw attention to them now. In such freshly prepared infusions we have not unfrequently seen appearances agreeing very closely with some of those figured by Dr. Bastian in his book as coming into existence *after* boiling, sealing, and preservation in a warm chamber. A freshly prepared and boiled strong infusion of hay may present shreds of vegetable fibre, a considerable number of dead *Bacterium termo* (some two or three to the field), minute, highly refringent spherules, varying from the size of a blood-corpuscle to the smallest size visible; and such spherules are often present in pairs, forming figure-of-8-shaped bodies, both smaller and larger than *Bacterium* and of different optical character. Further, dumb-bell-shaped bodies are not unfrequently to be observed of similar form and size to *Bacteria*, but coarser in outline; they dissolve on addition of HCl, which *Bacteria* do not*. All these bodies exhibit constant oscillatory (Brownian) movements. The addition of new cheese to such an infusion (as shown by

* In the most carefully guarded of the experiments published by Dr. Child a few years since in the 'Proceedings of the Royal Society,' a very small number of bodies similar to these were obtained; and we suggest that they were of the same nature.

examination of a simple infusion of new cheese taken by itself) adds a considerable number of highly refringent spherules of various sizes (oil-globules) and finely granular flakes, also a few *Bacteria* and (if the cheese be not quite new, almost certainly) fungus-mycelium and conidia in quantity.

Fresh-boiled turnip-infusion alone may contain so very few dead *Bacteria* that none are detected with the microscope, or only one in a drop. It presents a great number of minute, highly refringent spherules, varying in size from $\frac{1}{5000}$ inch downwards, all in most active oscillatory movement. Shreds and filaments of various sizes and character also are found, and a few finely granular flakes about $\frac{1}{1000}$ inch in diameter. The addition of cheese brings in, of course, the objects enumerated above as belonging to it.

Visibility of Bacteria.—It is perhaps necessary to say, before proceeding further, that we have satisfied ourselves that, in infusions of the optical character of those used, the multiplication of *Bacteria* makes itself obvious by a cloudiness. Hence, though we have not remained content with that evidence, the retention by such a limpid infusion of its limpidity is a proof of the absence of *Bacteria*. We also should mention, what is well known already, that in a closed tube or bottle, after such a cloud (of *Bacteria*) has developed, the *Bacteria* at a certain period cease to multiply and settle down as a fine powder, leaving the fluid again clear. Such precipitated *Bacteria* remain unchanged in the fluid for a long period (weeks certainly, perhaps years), and can be readily shaken up and at once recognized by microscopic examination; they are, moreover, not destroyed by boiling: hence it is not possible to miss the detection of a development of *Bacteria* in a limpid turnip-infusion, examined daily for three weeks or more by the naked eye, and finally, after agitation, by means of the microscope.

SERIES A. Nov. 23rd. *Experiments with hay-infusion.*—An infusion was prepared by pouring water of about 90° C. on to chopped hay. The infusion was of a dark sherry-colour; reaction slightly acid. The glass tubes used in this and subsequent experiments were about five inches in length, of half inch bore, rounded at one end and drawn out to a capillary orifice at the other. The infusion in these and subsequent experiments was introduced by heating the tube and plunging its capillary beak beneath the surface of the experimental liquid during the cooling of the expanded air, until the tube was about one third or half filled. Tubes 1, 2, 3 were half filled with the hay-infusion previously filtered, the liquid was boiled in the tube, and the capillary beak fused, as nearly as possible, during ebullition *.

* The tubes were sealed at the moment of removal from the flame over which they had been boiling. In every case a subsequent recurrence of ebullition was observed during the cooling of the upper part of the tube. Dr. Roberts, of Manchester, has suggested that the occurrence of *Bacteria* in tubes thus sealed may be explained by their in-draught, together with a certain amount of air, at the moment of closure; but the experiments of Sanderson, recently confirmed by Cohn, have shown that contamination of fluids by *Bacteria* only takes place through the medium of impure surfaces or liquids.

Tubes 4, 5 were similarly treated, with the difference that a small quantity of cheese, in a very fine state of division, had been added to this portion of the hay-infusion before its introduction into the tubes.

Tubes 6, 7. Quantity and character of the infusion as in 1, 2, 3, but the tubes sealed without previous ebullition.

Tube 8. Quantity and character of the infusion as in 4 and 5, but the tube sealed without previous ebullition.

Tubes 9, 10, 11. Quantity and character of the infusion as in 1, 2, 3, but rendered slightly alkaline with KHO. Sealed approximately during ebullition.

All these tubes (1 to 11) were after closure completely submerged in boiling water for fifteen minutes, and were then preserved in a hot-air bath, varying in temperature from 30° C. to 35° C.

Microscopic and naked-eye appearances of the hay-infusion at the time of sealing the tubes.—The infusion in tubes 1, 2, 3, 6, 7 was clear and pellucid, that in tubes 4, 5, 8, 9, 10, 11 was hazy.

Microscopic examination gave the result indicated above, as to the appearances of freshly prepared hay and hay-and-cheese infusion.

Subsequent appearances of the infusion in Tubes 1–11.—The tubes with infusion which was pellucid at the first were found to retain this character for several weeks, being preserved in the air-bath and examined from day to day. The hazy infusions were opened after four days, and their contents found to be unchanged.

A portion of the same hay-and-cheese infusion, boiled and purposely contaminated by preservation in an uncleaned beaker, was found after four days to be teeming with *Bacterium termo* exhibiting vital movements. The pellucid infusions were subsequently examined with the microscope at different times and found to be unchanged.

SERIES B. Nov. 25th. *Experiments with turnip-and-cheese infusion.*—An infusion was made with 700 grms. sliced white turnip and 1000 grms. water, to which about 1 grm. finely minced new cheese was added, the jug containing the mixture being maintained for four hours on a sand-bath at a temperature of 45°–55° C.

The infusion was now filtered; sp. gr. of the infusion 1011·1. Reaction slightly acid.

Tubes 12, 13, 14. Sealed cold. Submerged in boiling water for thirty minutes.

Tubes 15, 16, 17, 18, 19. Sealed approximately during ebullition. Submerged in boiling water for thirty minutes.

The tubes were preserved in the air-bath as in Series A.

Microscopic and naked-eye appearances of the infusion at the time of sealing the tubes.—The liquid in all the tubes was perfectly clear and limpid. A few shreds and flakes were obvious, which appeared to be derived from the filter-paper and from the slight precipitation of albuminous matter. The microscopic appearances were those above described as characterizing such infusions.

Subsequent appearances of the infusion.—The infusion in all the tubes was found on examination from day to day to retain its limpidity. Subsequent microscopic examination of all the tubes at various periods subsequent to the closure of the tubes (from four days to three weeks) yielded no indication whatever of a development of *Bacteria* or other organisms, nor of any change. A portion of the same infusion placed in an uncleansed beaker for comparison was milky and swarming with *Bacteria* after three days.

Series C. Nov. 28th. *Experiments with turnip-and-cheese infusion.*—The infusion similar in all respects to that in series B, but prepared with a somewhat larger proportion of turnips; therefore of higher specific gravity, which was not numerically determined.

Tubes 20, 21, 22, 23. Boiled and sealed approximately during ebullition. Not subsequently submerged.

Tubes 24, 25. Boiled and sealed approximately during ebullition. Subsequently submerged in boiling water during thirty minutes.

The tubes were preserved in the air-bath as in Series A and B.

Series D. Nov. 30th.—An infusion prepared as in Series B and C, but brought to a sp. gr. 1031 by evaporation after filtration.

Tubes 26, 27, 28, 29. Sealed cold. Subsequently submerged in boiling water for thirty minutes.

Tubes 30, 31. Boiled and sealed approximately during ebullition. Not subsequently immersed.

Tubes 32, 33. Boiled and sealed approximately during ebullition. Subsequently submerged in boiling water for thirty minutes.

Appearances in the infusions, Series C and D, at the time of sealing and submerging.—The appearances in the freshly prepared infusion were similar to those described above as characterizing such infusions.

Subsequent naked-eye examination of the tubes did not reveal the slightest change; they remained limpid. Specimens from each group were opened and examined with the microscope after four days, and the microscopic characters found to be unchanged: the liquid was perfectly sweet. The remaining tubes were examined at intervals before the end of December, being maintained during the whole time at a temperature of 35° to 40° C. in the air-bath; they equally proved to have remained unchanged when opened and examined with the microscope, and were also free from unpleasant smell.

Series E. Nov. 28th.—Six porcelain capsules were heated to redness, and nearly filled with the turnip-infusion used in Series C. They were placed on the air-bath under a glass shade.

Capsules 1, 2. The infusion was unboiled.

Capsule 3. The infusion was boiled in the capsule.

Capsule 4. The infusion was introduced after it had been boiled for five minutes in a superheated test-tube.

Capsules 5 and 6. The infusion was that used in capsule 4, but a drop of distilled water was added to each of these two capsules.

After four days the infusion in capsules 1, 2, 5, and 6 was found to be teeming with *Bacterium termo* and Bacterian filaments.

Capsule 3 was found to be cracked, and hence was discarded (it swarmed with *Bacteria*).

Capsule 4 was perfectly free from organisms, and remained so during a fortnight, when a fungus-mycelium made its appearance on the surface.

Series F. Dec. 10th.—A strong infusion of turnip and cheese, prepared as in Series B (sp. gr. 1013), was boiled in an eight-ounce flask for five minutes. Three common test-tubes were superheated and placed in a beaker to support them.

No. 1. The infusion was poured in, and with it one drop of distilled water.

No. 2. The infusion was poured in and thus left.

No. 3. The infusion was poured in and again boiled for two minutes.

These and the flask containing the remaining infusion were left on a shelf for one day; on Dec. 11, there being no cloudiness in any of the four, they were placed on the top of the hot-air bath. On Dec. 13 No. 1 was found to be swarming with *Leptothrix*-growths and free *Bacterium termo.*

No. 2 also was cloudy and swarmed with what Cohn calls the rosary-chains. No. 3 was absolutely free from all devélopment of life, and was perfectly sweet and limpid; so also was the fluid in the original flask, a large one capable of holding eight ounces. How is the development of *Bacteria* in No. 2 to be explained? The original fluid remains pure; the fluid in No. 3, which was reboiled, remains so too; the tube itself, No 2, had been heated red-hot and could not be a source of contamination. One's attention was therefore directed to the conditions of the passage of the fluid from the flask into the tubes; and here an explanation at once offered itself. The large flask *had not been superheated*; its lip was still dirty, laden with *Bacteria* ready to contaminate fluids as they poured from it; hence the contamination of the fluid in test-tube No. 2. The validity of this explanation cannot be disputed, because it is known that such glass surfaces, unless specially cleansed, invariably contaminate infusions exposed to them.

Series G. Feb. 11th.—The publication of Dr. Burdon Sanderson's letter, describing some experiments made by Dr. Bastian, induced us to make a further series of experiments with important modifications. We had expressly avoided the introduction of any thing like visible lumps of solid cheese or turnip into our infusions during their ebullition, believing that such lumps were a possible source of the exclusion of *Bacteria* or their germs from the killing influence of the boiling temperature. This precaution we had supposed (in the absence of any statement to the opposite effect) to have been taken by Dr. Bastian in the experiments adduced by him in the 'Beginnings of Life.' The presence of such lumps was publicly suggested in discussion at the British-Asso-

ciation Meeting at Liverpool as a source of fallacy, and has been demonstrated to be so by Dr. Ferdinand Cohn in experiments made with peas and infusion of peas ('Beitrage zur Biologie der Pflanzen,' Breslau, 1872). Further, we had limited the bulk of our infusions and the size of our experimental tubes, in view of the obvious consideration that the larger the mass and area to be guarded against contamination the greater the chance of failure in that respect. Thirdly, it had not occurred to us to make use of vessels in these experiments of a form so inconvenient and difficult to thoroughly guard against effects of "spluttering," and to thoroughly heat by boiling, as the retort. Nor could we guess, in the absence of any directions on that point from Dr. Bastian, that it was desirable to exclude the rind of the turnip from the preparation of the infusion. The correspondence in 'Nature,' however, indicated that "pounded" cheese (necessarily in a condition of solid lumps) was added (in some cases) to his *experimental vessels after the turnip-infusion*, and was present during ebullition. It also appeared that retorts capable of holding two ounces were the vessels used; whilst, on grounds not given, it was considered advantageous by Dr. Bastian to peel the turnips before slicing them.

The following experiments were accordingly made:—

An infusion of turnip (minus the rind) was prepared and filtered; it had sp. gr. 1012·7. In the experiments Nos. 34 to 47 two ounce retorts were used, and the bulb half filled with the experimental infusion.

No. 34. The infusion neutralized with KHO. About two grains of pounded cheese in pellets added to the retort.

Nos. 35, 36. Infusion not neutralized. About two grains of pounded cheese in pellets added to the retort.

Nos. 37, 38, 39. The simple infusion.

No. 40. The simple infusion, to which were added a few drops of an emulsion of cheese prepared with some of the turnip-infusion and new cheese, the emulsion having been filtered.

No. 41. The simple infusion.

Nos. 34 to 40 were boiled for five minutes; they were then preserved in the air-bath at a temperature of 35° C., and sealed approximately during ebullition. Four of them, including No. 36, were subjected to a further boiling of fifteen minutes in a water-bath after sealing.

No. 41 was boiled for five minutes and placed on a shelf with its mouth open.

Subsequent appearances in Retorts Nos. 34–41.

On Feb. 15th Nos. 34, 35, 37 were opened and found to be perfectly sweet and free from a development of *Bacteria* or other organisms.

No. 41 was observed to be perfectly limpid, and is so still (March 17th).

On Feb. 27th Nos. 36, 38, 39, and 40 were opened. With the

exception of No. 36, they were perfectly sweet and free from organisms.

No. 36 had a slightly fœtid odour and swarmed with rather long *Bacteria*—that is, *Bacteria* longer than the common *B. termo*, which develops in infusions open to atmospheric air, but not quite of the form of the *Bacillus subtilis* of the butyric fermentation, which is stated to appear in some infusions, *e. g.* milk, to which the access of atmospheric air has been entirely prevented. It is to be noticed that in this series the only retort in which *Bacteria* made their appearance was one of those in which small *lumps* of cheese were present during the subjection of the flask to the process of ebullition and subsequent immersion in boiling water.

This result induced us to make a further series of differential experiments, bearing upon the influence of the state of aggregation of the cheese introduced into the turnip-infusion.

SERIES H. March 8th.—A turnip-infusion was prepared as in Series B; found after filtration to have sp. gr. 1113·5.

Tubes similar to those used in Series A–E, and half filled, were used.

Tubes 42, 43, 44. The simple infusion was poured into the tube, so as to half fill it; a lump of cheese the size of a pea was then added. Sealed cold.

Tubes 45, 46, 47. To the turnip-infusion, before introduction into the tubes, an emulsion of cheese prepared with turnip-infusion and strained through a piece of cambric was added. The tubes were then half filled with this mixture and sealed cold.

Tubes 48, 49, 50. The same as 42, 43, 44, but sealed approximately during ebullition.

Tubes 51, 52, 53. The same as 45, 46, 47, but sealed approximately during ebullition.

All the tubes, 42 to 53, were completely submerged during five minutes in boiling water, and subsequently preserved in the air-bath at 35° C. temperature.

On March 13th the contents of the twelve tubes were examined with the microscope. No. 45 had been broken in the boiling. The five remaining tubes which had been prepared with cheese in the finely divided condition were found to be entirely devoid of life, the infusion microscopically and otherwise unchanged. Of the six tubes prepared, each with a small lump of cheese, no organisms were detected in 42 and 44; but in 43 and 49 a few elongate *Bacteria* were observed (in the proportion of about two to the field of a Hartnack's system 10). In 48 and 50 the fluid was swarming with elongate *Bacteria* and true *Bacillus*. The lumps of cheese in those tubes in which life appeared had softened and spread out to a certain extent on the side of the tube. The cheese-lumps in Nos. 42 and 44 retained their original form.

From the result of these later experiments, made in consequence of the fuller information given by Dr. Sanderson as to Dr. Bas-

tian's mode of treating turnip and cheese so as to obtain phenomena supposed to be in favour of the doctrine of Archebiosis, we consider that the importance of excluding visible lumps from the experimental infusions is clearly indicated, as also is the comparatively greater trustworthiness of the small tube as opposed to the larger retort for use as an experimental vessel. We moreover consider that we, in our earlier experiments (November and December), carefully following Dr. Bastian's directions, as far as he had given any in the 'Beginnings of Life,' but using at the same time proper care as to cleanliness and due boiling, obtained a series of results contradicting Dr. Bastian's statements as to the spontaneous generation of *Bacteria* in infusion of turnip to which a fragment of cheese had been added.

Further, certain of the experiments above recorded, and others made at the same times with open vessels and simple turnip-infusion, compel us to dissent emphatically from the conclusion of the following statement contained in a recent paper by Dr. Bastian ('Nature,' Feb. 6th, p. 275):—"Taking such a fluid, therefore, in the form of a strong filtered infusion of turnip, we may place it after ebullition in a superheated flask, with the assurance that it contains no living organisms. Having ascertained also, by our previous experiments with the boiled saline fluids, that there is no danger of infection by *Bacteria* from the atmosphere, we may leave the rather narrow mouth of the flask open, as we did in these experiments. But when this is done, the previously clear turnip-infusion *invariably* becomes turbid in one or two days (the temperature being about 70° F.), owing to the presence of myriads of *Bacteria*." The italics are our own.

We find not only that such an infusion remains free from *Bacteria* when thus treated (subject, of course, to certain failures in the precautions taken) for "one or two days," but if contamination by the admission of coarse atmospheric particles capable of carrying *Bacteria* be guarded against, it will remain so for weeks and probably for years. In consequence of this absence of development of *Bacteria* we have cultivated *Torulæ* in such a turnip-infusion, so as to obtain them entirely free from the former organisms*.

In conclusion, we would point out that failure in manipulation, contamination in unsuspected ways, such as that due to the preservative influence of lumps, and, again, the mistaking of particles in an infusion which have been there from the first for organisms originated *de novo*, do not exhaust the list of conceivable explanations of phenomena which have been attributed to spontaneous generation. When the knowledge of the natural history of *Bacteria* has advanced somewhat further, there will be a possibility of such explanations presenting themselves in ways at this moment unsuspected.

* At this moment, May 20th, the turnip-infusion in the open retort (No. 41) is free from all organisms, and is perfectly limpid and sweet.

Whilst awaiting Professor Huizinga's fuller account of his experiments, we may point out that the hypothesis of an inhibitory influence of increased density should be supported by experimental evidence, and that it cannot apply to tubes closed before boiling. The neck of the flask closed with asphalt may (so far as conditions are stated by him at present) harbour *Bacteria*, as in our Series F. But especially we would urge upon him and others that it is undesirable, as yet, to introduce into the discussion other organic mixtures. Turnips and cheese may be very bad material for experiment; but it would be well, as far as possible, to settle the matter, or the way in which the matter is to be viewed with regard to them, before going off to other particular cases.

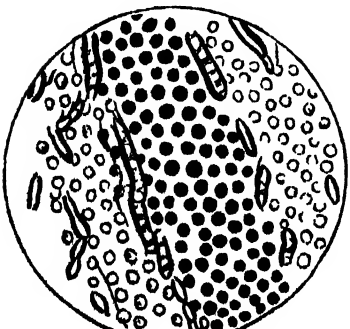
It would be a very excellent thing if all further reference to this subject could be postponed for a year or two—that is, until further study of *Bacteria*, such as that inaugurated by Sanderson and Cohn, has given us surer ground to tread upon.

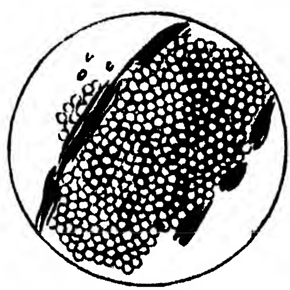
"Note on High-Power Definition as illustrated by a compressed *Podura*-scale." By E. B. Beaumont, F.R.S., and Dr. Royston-Pigott, F.R.S.

Nothing in microscopic matters has ever afforded us such complete satisfaction as the following result of a very fine definition, accomplished by means of a Gundlach German $\frac{1}{16}$ immersion lens, corrected by a new method, which Dr. Pigott at present delays publishing in the hope of further improvement, but which he is willing to exhibit at his house.

A *Podura*-slide *, fortunately strongly protected with a thick

Podura-scale.





glass cover, having accidentally been subjected to so considerable a pressure as to crush out the structure of a large scale, upon bringing it, by haphazard, into the field of view with a magnifying-power of about 2000 diameters, exhibited a structure indicated by

* *Podura Degeeria* vel *domestica*.

the woodcuts here given, and drawn, in the presence of the writers, at Dr. Pigott's house by the accurate artist Mr. Hollick, deaf and dumb and a rapid delineator without the camera. Mr. Beaumont's surprise and admiration equalled that of Dr. Pigott. This circumstance will excite no surprise when it is stated that for four years the spherules of the *Podura* have been generally denied and warmly disputed. In ordinary cases a crushed scale shows nothing; and as glasses are usually corrected to show the illusory spines or markings, these spherules are concealed.

The idea conveyed was, that two layers of spherules (first detected by Mr. Beaumont within the tubes), like two confined layers of small shot, had, by compression, been forced and largely spread out into broader layers. It was thought also that detached portions resembled long tubes or puckers filled with spherules exactly fitting them. The spherules appeared perfectly spherical, but somewhat unequal in size.

In the general flattened and extended surface of the compressed and disintegrated scale the spherules appeared dark blue or red, according to the slight change in the focal plane, and in a still lower plane white.

In the adjoining uninjured scales long strings of beads were seen, like necklaces of coral, here and there sharply bordered with black lines, apparently denoting tubes of membrane or puckers enclosing them like a tube. Between these strings of spherules peeped forth others of a light orange-colour.

The slide was an old one and well known. The mass of the crushed scale occupied a much broader space than any of the scales.

November 20, 1873.—Sir George Biddell Airy, K.C.B., President, in the Chair.

"Note on the Electrical Phenomena which accompany irritation of the leaf of *Dionæa muscipula*." By J. Burdon Sanderson, M.D., F.R.S., Professor of Practical Physiology in University College.

1. When the opposite ends of a living leaf of *Dionæa* are placed on non-polarizable electrodes in metallic connexion with each other, and a Thomson's reflecting galvanometer of high resistance is introduced into the circuit thus formed, a deflection is observed which indicates the existence of a current from the proximal to the distal end of the leaf. This current I call the *normal leaf-current*. If, instead of the leaf, the leaf-stalk is placed on the electrodes (the leaf remaining united to it) in such a way that the extreme end of the stalk rests on one electrode and a part of the stalk at a certain distance from the leaf on the other, a current is indicated which is opposed to that in the leaf. This I call the *stalk-current*. To demonstrate these two currents, it is not necessary to expose any cut surface to the electrodes.

2. In a leaf with the petiole attached, the strength of the current is determined by the length of the petiole cut off with the leaf, in such a way that the shorter the petiole the greater is the deflection. Thus in a leaf with a petiole an inch long, I observed a deflection of 40. I then cut off half, then half the remainder, and so on. After these successive amputations, the deflections were respectively 50, 65, 90, 120. If in this experiment, instead of completely severing the leaf at each time, it is merely all but divided with a sharp knife, the cut surfaces remaining in accurate apposition, the result is exactly the same as if the severance were complete; no further effect is obtained on separating the parts.

3. *Effect of constant current directed through the petiole on the leaf-current.*—If the leaf is placed on the galvanometer electrodes as before, and the petiole introduced into the circuit of a small Daniell, a commutator being interposed, it is found that on directing the battery-current down the petiole (i. e. *from* the leaf), the normal deflection is increased; on directing the current *towards* the leaf, the deflection is diminished.

4. *Negative variation.*—*a.* If, the leaf being so placed on the electrodes that the normal leaf-current is indicated by a deflection *leftwards*, a fly is allowed to creep into it, it is observed that the moment the fly reaches the interior (so as to touch the sensitive hairs on the upper surface of the lamina), the needle swings to the right, the leaf at the same time closing on the fly.

b. The fly having been caught does not remain quiet in the leaf; each time it moves, the needle again swings to the right, always coming to rest in a position somewhat further to the left than before, and then slowly resuming its previous position.

c. The same series of phenomena present themselves if the sensitive hairs of a still expanded leaf are touched with a camel-hair pencil.

d. If the closed leaf is gently pinched with a pair of forceps with cork points, the effect is the same.

e. If the leaf-stalk is placed on the electrodes, as before, with the leaf attached to it, the deflection of the needle due to the stalk-current is *increased* whenever the leaf is irritated in any of the ways above described.

f. If half the lamina is cut off and the remainder placed on the electrodes, and that part of the concave surface at which the sensitive hairs are situated is touched with a camel-hair pencil, the needle swings to the right as before.

g. If, the open leaf having been placed on the galvanometer electrodes as in *a*, one of the concave surfaces is pierced with a pair of pointed platinum electrodes in connexion with the opposite ends of the secondary coil of a Du Bois-Reymond's induction apparatus, it is observed that each time that the secondary circuit is closed the needle swings to the right, at once resuming its former position in the same manner as after mechanical irritation. No difference in the effect is observable when the

direction of the induced currents is reversed. The observation may be repeated any number of times; *but no effect is produced unless an interval of from ten to twenty seconds has elapsed since the preceding irritation.*

h. If the part of the concave surface of the leaf which is nearest the petiole is excited, whether electrically or mechanically, the swing to the right (negative variation) is always preceded by a momentary jerk of the needle to the left, *i. e.* in the direction of the deflection due to the normal leaf-current; if any other part of the concave surface is irritated, this does not take place.

i. Whether the leaf is excited mechanically or electrically, an interval of from a quarter to a third of a second intervenes between the act of irritation and the negative variation.

MISCELLANEOUS.

Observations on the Existence of certain Relations between the Mode of Coloration of Birds and their Geographical Distribution. By M. A. Milne-Edwards.

In carrying on my researches on the geographical distribution of animals in southern regions, I have been struck with certain relations which seem to exist between the parts of the globe inhabited by birds and the mode of coloration of those animals; and wishing to know the degree of importance that ought to be ascribed to this observation, I have tried to examine more carefully than had previously been done what may be called the geographical distribution of colours in birds. In fact this investigation seemed to me capable of throwing some light on the influence which local biological conditions may exert upon the secondary zoological characters of species and races. To furnish significant results it ought to bear principally upon the natural groups which have a very wide geographical distribution; and in order that it may have the necessary degree of precision, it ought to be founded upon the chromatic analysis of the plumage and the comparison of its colours with well-defined normals. Without the aid furnished by the chromatic circles, for which science and the arts are indebted to M. Chevreul, it would have been difficult for me to appreciate thoroughly the tones and shades which I had to take into account, and still more difficult to formulate clearly the results furnished by observation; but by means of these circles this labour has been remarkably facilitated.

In a first series of investigations I attended specially to various degrees of melanism; and in order to judge of the relative influence of black upon the plumage of birds inhabiting various geographical regions, I took into account not only the extent of the parts of the tegumentary system which are tinted in that manner, but also the degree in which the other colours may be dulled or modified in their tone by mixture with black in various proportions.

Birds with black plumage are found in nearly all parts of the globe; but in certain families, of which the geographical extension is very wide, the tendency to melanism is scarcely shown except in the southern hemisphere, and more particularly in the oceanic region which includes New Zealand, Papuasia, Madagascar, and the intermediate countries. A remarkable example of this coincidence between the mode of coloration of birds and their distribution on the surface of the globe is furnished by the family of the swans. In the northern hemisphere this family has numerous representatives whose plumage is entirely white; in the southern hemisphere this is not the case, and a more or less considerable portion becomes intensely black. Thus the Australian swan is almost entirely black; the coscoroba, or *Cygnus anatoides*, which is confined to the Fuegian archipelago and neighbouring countries in South America, has some of the wing-feathers black, and it is by this character alone that it differs from the Chinese coscoroba (*C. Davidii*); lastly, in the swan of Chili, the head and neck are jet-black, whilst the rest of the body is pure white. These are the only species of swans which live in the southern hemisphere.

These peculiarities would have but little interest if they were isolated: but this is not the case; and the examination of the geographical distribution of the colours of the parrots furnishes us with still more manifest proofs of the tendency to melanism in the vast oceanic region which includes New Zealand, Papuasia, and the intermediate lands.

Black or nearly black parrots are not met with in America, Asia, or Africa (except on the borders of the Mozambique channel), but they are not uncommon in the southern region contained within the limits already mentioned; and it is there especially that we find the species or local races in which the plumage only presents strongly toned-down tints. Thus, in New Zealand and the adjacent islands, these birds, instead of presenting bright colours, are more or less tinged with black. The Nestors, for example, have dull brown plumage; the larger feathers of the wings and tail, wherever they are exposed to the light, are almost uniformly of a brown tint, resembling that produced by a mixture of nine parts of black with one part of orange-red; on the shoulders, the greater part of the back, the head, and the breast the feathers have a brown border of a still deeper tint; and in the rest of their surface similar tints are mitigated by white, so as to become more or less greyish; and it is almost solely on the tail-coverts and the inner surface of the wings and on the corresponding portion of the flanks, which are not habitually exposed to the light, that an orange-red colour but slightly toned down shows itself here and there.

The *Strigops* or night-parrots of New Zealand also in great part owe their peculiar aspect to another kind of melanism, affecting a greenish ground, and mixed with parts modified by albinism. This yellowish green, which belongs to Nos. 3 and 4 of the chromatic circles, is far from being pure; it is toned down by about $\frac{3}{10}$ or $\frac{4}{10}$ of black, and is interrupted above by spots and irregular bands of

nearly pure black and also by whitish streaks, whilst below and on the sides of the head the spots are due almost entirely to albinism. These mixtures, in which black plays a great part, produce a dull and speckled plumage which, up to a certain point, resembles that of our owls.

The tendency to melanism occurs also in the parroquets of New Zealand. These birds belong to the group of the Platycerci of which ornithologists have formed the genus *Cyanorhamphus*. Its plumage is of a dull green; a little pure red or yellow is still to be seen on the forehead or on some other very restricted parts; all the upper part of the body of the bird is of a yellowish-green colour much toned down with black, and below a similar but lighter tint spreads almost uniformly. In *Cyanorhamphus alpinus* the dominant coloration nearly corresponds to the yellowish green of the gamut No. 4, toned down by $\frac{5}{10}$ of black; in *C. novæ-zelandiæ*, the yellowish green belongs to the gamut No. 2 and to that No. 3, but it is dulled by $\frac{8}{10}$ of black; lastly, in *C. auriceps* the general tint of the plumage agrees with the yellowish green No. 1, toned down by $\frac{8}{10}$ of black over the whole upper surface of the body.

The islands of the great Indo-Pacific Ocean which are near Africa resemble New Zealand as regards the coloration of the plumage of their parrots. Thus in Madagascar, in the Mauritius to the east, and in the Seychelles and Comoro islands towards the north, and even on some parts of the neighbouring shore of Africa, we find several black species of parrots belonging to the genus *Coracopsis*.

In Australia the *Calyptorhynchi* abound; and the whole of their plumage is of an intense black colour or softened with white. Many of the Australian parroquets have pure colours in the same degree as those of America; but in many of these birds the tendency to melanism makes its appearance in various parts of the body, sometimes by the existence of a uniform tint very much toned down, and sometimes by the whole basal part of the feathers being invaded by black, which only bears near the margins a more or less narrow band of red, yellow, green, or blue.

In the memoir, of which I could only give a short abstract here, I review several other ornithological families which have furnished analogous facts and show the same tendencies—for example, the families of the Kingfishers, *Rallidæ*, and Ducks. But I have no space to speak of them here; and the facts which I have indicated suffice to show that in the southern Indo-Pacific region the ornithological types which elsewhere are clothed with brilliant colours, generally have tints toned down with black or weakened by a tendency to albinism. —*Comptes Rendus*, December 29, 1873, pp. 1551–1554.

On the Genus Callignathus *and on* Kogia Floweri *of Dr. Gill.* By Dr. J. E. Gray, F.R.S. &c.

Dr. Theodore Gill, in a semipopular paper on "Sperm-whales giant and pigmy," in the 'American Naturalist,' 1871, iv. p. 725, gives a general account of these animals, and proposes a new species,

Kogia Floweri, from Mazatlan, Lower California—described from a specimen consisting of the front of a lower jaw, and from the figure and notice of the animal, measuring nine feet in length, recently forwarded to him by Colonel Grayson. It is very interesting as proving that this genus is found in the North Pacific. The account and figure of Dr. Gill are so very like that of *Kogia MacLeayi* that I should not be at all surprised if *Kogia breviceps* from the Cape of Good Hope, *Kogia MacLeayii* from Australia (which has been proved not to be distinct from the skull of *Physeter simus* from the east coast of India), and *Kogia Floweri* from Mazatlan are all the same species, naturally inhabiting, like the sperm-whale, the tropical regions and wandering to the north and south, as the same species has been found on both sides of the equator.

From the comparison of the photographs which Mr. Krefft sent me, with the skull from Madras (described by Professor Owen) in the British Museum, I could find no difference, as stated in the 'Catalogue of Seals and Whales in the British Museum,' 1866, p. 392; and the comparison of the skulls since sent by Mr. Krefft has established the identity of the Australian specimens from the south and Indian from the north of the equator. Dr. Gill, having overlooked this observation (published in 1866), observes that a generic name will sooner or later be desired for *Kogia simus* from Madras, and therefore proposes to call it *Callignathus simus* (p. 738)—and copies Owen's figure of the young skull (p. 741, figs. 168–171), which is not to be confounded with the skeleton that Professor Owen copies from Krefft's photograph of *Euphysetes Grayii*, quite a distinct whale of the same group.

On the Development of the Phragmostracum of the Cephalopoda, and on the Zoological Relations of the Ammonites to the Spirulæ. By M. Munier-Chalmas.

I have the honour to submit to the Academy the results of the observations which I have made on the development of the phragmostracum of the Cephalopoda in the laboratory of palæontological research at the Sorbonne, under the guidance of M. Hébert.

This comparative embryogenic investigation proves very clearly that the Ammonites are not tetrabranchiate Cephalopoda allied to the *Nautili*, as is generally supposed, but dibranchiate decapod Cephalopoda, having the greatest affinity to the *Spirulæ*.

As early as 1867 M. J. Barrande had proved, in his great work on the Silurian system of Central Bohemia, the small resemblance that exists between the Goniatites and the Nautilidæ during the first period of their development. In fact, the initial chamber of the phragmostracum of the Cephalopoda of the Nautilide group, except as regards the external cicatrix, does not sensibly differ in its general organization from the other primary chambers which are developed a little later. In speaking of *Cyrtoceras* M. Barrande moreover expresses himself as follows:—"We shall also call attention to the

fact that this form of the origin of the shell, which occurs also in *Orthoceras*, appears to be similar in all the types of Nautilidæ in which we have observed it hitherto. It contrasts, on the other hand, with the origin of the shell of the Goniatites, which appears in the form of an *egg*, isolated from the first air-chamber by a distinct constriction."

This initial chamber (ovisac) of the Goniatites, so different from those which immediately succeed it, is met with at the origin of the phragmostracum of all the dibranchiate Cephalopoda that I have been able to study.

The new and very interesting investigations carried on at Philadelphia by Mr. Hyatt, upon the embryogeny of the phragmostracum of *Nautilus pompilius, Deroceras planicosta*, and the Goniatites, come in support of these observations. It must be added, however, that Mr. Hyatt, preoccupied by his theoretical ideas upon the evolution of living creatures, in order to establish the filiation of the Ammonites and *Nautili*, supposes that the latter lost their ovisac by truncation. To support this supposition, he adduces the transverse external cicatrix which he observed on the initial chamber of *Nautilus pompilius*.

The numerous observations which I have since been able to make upon the termination of the siphon in *Aturia zigzag*, in the Jurassic, Cretaceous, and Tertiary *Nautili*, and in the three existing species, the microscopic examination of a transverse section of the initial chamber of *Nautilus pompilius* and *N. umbilicatus*, and a careful comparison of those Silurian Cephalopoda which lose the extremity of their phragmostracum by truncation have led me to a result completely opposed to the theoretical views put forward by Mr. Hyatt, but conformable in all points with the facts observed by M. Barrande.

The comparative examination which I have made of the ovisacs of *Spirula Peronii* and of *Ammonites Parkinsoni*, *A. ooliticus*, *A. mamillaris*, &c. has shown me the relations which exist between these two types during their embryonic evolution. In fact, in the *Spirulæ* and the Ammonites the siphon originates in the ovisac a little before the appearance of the first septum. It commences by a cæcal inflation, which bears the prosiphon in its prolongation. The new organ to which I give the name of *prosiphon* must take the place of the siphon during the embryonic period. It originates in the ovisac, opposite the siphonal inflation, upon which it terminates, but without having any internal communication therewith. It is very variable in its general form, and may present a strongly marked example of dimorphism in the same species of Ammonite. It is formed by a membrane, which is sometimes simply spread out as in *Spirula Peronii*, or which may form a more or less circular tube. It also sometimes presents two, three, or four small subdivisions at its point of insertion upon the inner wall.

I have ascertained the presence of an ovisac in the genera *Belemnites*, *Belemnitella*, *Beloptera*, *Belopterina*, *Spirulirostra*, *Ammonites*, and *Ceratites*. In *Deroceras*, *Clymenia*, and *Goniatites* its

general form and its relations with the siphon are the same as in all the Ammonites. It is generally spheroidal when the turns of the spire are free, and ovoid when they are contiguous.

In the tetrabranchiate Cephalopoda which live in our present seas and in all those which swarmed by thousands in the ancient seas, the presence of an ovisac has never been detected. In *Nautilus* and *Aturia* the siphon originates upon the inner walls of the first chamber. It is completely closed at its posterior extremity by a part of the calcareous prolongation of the septum which assists in its formation. The external transverse cicatrix observed by Mr. Hyatt can never have been in communication with the siphon; its purpose is still completely unknown. It has been indicated by M. Barrande upon a great number of Silurian Tetrabranchiata.

Thus it results from these observations that at the Silurian epoch the tetrabranchiate Cephalopoda were as clearly separated from the dibranchiate as at the present day. The only modifications that we can recognize are of generic rank; in fact the Ammonites which, when young, have septa like those of *Deroceras* and *Goniatites*, appear to be derived from one of those types.—*Comptes Rendus*, December 29, 1873, pp. 1557–1559.

On the Endomycici. By the Rev. H. S. Gorham.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—My attention has been called to a brief notice you have given of my descriptive catalogue of the Endomycici. The question of classification, I venture to submit, is rather an experimental than a logical one, and must be influenced by the amount of knowledge possessed of the objects to be classified; so that a group of genera which fifteen years ago were united into a family may now, by the addition of fresh genera, require subdividing into a group of families; and yet it may be convenient to retain as nearly as possible the original title for the whole group, though of course the patronymic termination must be altered.

Had the reviewer, however, been acquainted with Gerstäcker's 'Entomographien,' he would have known that that author recognized two '*groups*,' "zwei sehr ungleiche Gruppen"—I. Endomychidæ genuini, II. Endomychidæ adsciti.

Whether it is illogical to attempt the union of these, or unnecessary to reconstruct the latter (which is a heterogeneous miscellany), I will leave to those who follow me to determine.

As your reviewer is so hard to please in the selection of names, he should at least have quoted correctly the one he terms awkward. I have no family "Paussidoidæ," but one Paussoïdeidæ.

The only genus in this family is *Trochoïdeus*, Westw. Would he have thought Trochoïdeidæ less awkward or more expressive?

I am, Gentlemen, yours truly,
H. S. Gorham.

Shipley, January 19, 1874.

On the Bermuda Humpbacked Whale of Dudley (Balæna nodosa, *Bonnaterre*, Megaptera americana, *Gray*, *and* Megaptera bellicosa, *Cope*). By Dr. J. E. Gray, F.R.S. &c.

In the 'Proc. Amer. Phil. Soc.,' October 1870, Mr. Cope describes the skeleton of a humpbacked whale as *Megaptera bellicosa*, sent from St. Bartholomew, West Indies, to Philadelphia, and figures the upper part of the skull and various parts of the skeleton. It agrees with the northern *Megaptera longimana* in having a scapula without any processes; but differs in the form of the atlas vertebra, the nasals, and other parts of the skeleton. It is evidently a very distinct species.

The American whalers are now in the habit of catching humpbacked whales off the coast of San Domingo and in other parts of the Caribbean seas. "Dr. A. Goës, of St. Bartholomew, says that the whales appear about the island of St. Bartholomew about the beginning of March, or even in February, and remain until the end of May. In April and May it is said that they are seen in pairs standing vertically in the water. When they return they often come in a family of three, male, female, and young (the calf one or two years old). The bull is wild and more difficult to take than the female, and he has on two occasions smashed the boat of his pursuers to pieces. In June they are said to go further into the Mexican Gulf, and return eastward in the autumn; but they do not appear among the smaller Antilles at that time. Dr. Goës supposes that they pass the Straits of Florida, or follow the shores of the south main. He says that the whalers think they pass the middle of winter on the African coast; but this will require confirmation."

This whale is no doubt the same as the "Bunch or Humpbacked Whale" of Dudley (noticed, with an account of the method of taking it, in the 'Philosophical Transactions' for 1665), from Bermuda (where it lives from March to the end of May), on which Bonnaterre established *Balæna nodosa*, and is the *Megaptera americana* of Gray, 'Zool. Erebus and Terror,' pp. 17 & 52, of which *Megaptera bellicosa*, Cope, will be a synonym.

By a curious perversity Mr. Cope refers to the Bahia finner, but makes no reference to or comparison with the Bermuda humpback, though Dudley and Dr. Goës say that they inhabit the Caribbean seas at the same period of the year.

On some recent Remarks by Mr. Meldola upon* Iphiclides Ajax (Papilio Ajax *auct.*). By Mr. S. H. Scudder.

These remarks were made in connexion with investigations "on the amount of substance-waste undergone by insects in the pupal

* Ann. & Mag. Nat. Hist. xii. pp. 301-307 (Oct. 1873).

state." It was presumed *à priori* that, as there was gain of matter in the larval state and loss during the pupal, the size of an individual of any species "would be, *cæteris paribus*, inversely proportional to the ratio of the pupal to the larval period, or directly proportional to the ratio of the larval to the pupal period."

Mr. Meldola attempted to test this theory by tabulating the statements of Mr. Edwards concerning the duration of the stages in the different polymorphic forms of *Ajax*; and he found "that there was a relationship, but exactly the reverse of that which would be anticipated from the conclusions previously set forth."

The three forms of *Ajax* have been called by Mr. Edwards *Walshii*, *Telamonides*, and *Marcellus*; and these increase in size in regular ratio and succeed each other in season in this order. The following table represents the duration of the several stages, and is taken by Mr. Meldola from Mr. Edwards's work:—

	Eggs.	Larva.	Chrysalis	Total.
Walshii	7–8 days.	22–29 days.	14 days.	43–51 days.
Telamonides .. .	4–5	15–18	11–14	30–36 "
Marcellus	4–5	12–19	11–14	27–38 "

The next table is Mr. Meldola's attempted tabulation of the facts by which he comes to the above conclusion:—

Name of variety.	Ratio of mean pupal to mean larval period.	Ratio of mean larval to mean pupal period.	Mean expanse, ♂.
			inches
Walshii	$\frac{14}{25\cdot5}=0\cdot549$	$\frac{25\cdot5}{14}=1\cdot821$	2·70
Telamonides ..	$\frac{12\cdot5}{16\cdot5}=0\cdot757$	$\frac{16\cdot5}{12\cdot5}=1\cdot320$	3·00
Marcellus .	$\frac{12\cdot5}{15\cdot5}=0\cdot806$	$\frac{15\cdot5}{12\cdot5}=1\cdot240$	3·35

"It is here seen," says Mr. Meldola, "that the size of the variety is directly instead of inversely proportional to the ratio of the pupal to the larval period, and *vice versâ*." Unfortunately for this conclusion the figures given by Mr. Edwards, or their reduction by Mr. Meldola, refer in each case to the *progeny* of *Walshii*, *Telamonides*, and *Marcellus*, and do not bear upon the question; in every instance given in the tables the progeny or resultant is *Marcellus*; *Walshii* and *Telamonides* are the produce of wintering chrysalids, and therefore by Mr. Meldola's rule should be, as they are, smaller than *Marcellus*, which, on the other hand, is always the result of short-lived summering chrysalids. Unless, however, some unknown factor plays a part, *Telamonides* should be smaller than *Walshii*, because produced later in the season from wintering chrysalids; but here the opposite is the truth.

Mr. Edwards apparently overlooked the fact that *Walshii* and

Telamonides belonged to the same brood; the former consists of earlier, the latter of later individuals from wintering chrysalids; the second brood of the species (the first from short-lived chrysalids) is *Marcellus*, and made up of the mingled progeny of both *Walshii* and *Telamonides*.—*From an advance proof of the Proceedings of the Boston Society of Natural History*, October 22, 1873.

The Habitat of Labaria hemisphærica. By Dr. J. E. Gray, F.R.S. &c.

In reply to Dr. Meyer's communication at p. 66, I see I am wrong in not giving Cebu as the habitat of these sponges; but as I received the box of sponges some time after I received the letter containing their habitat, although he said I should receive the two together, I had forgotten that the one referred to the other. I am astonished to observe that Dr. Meyer says, "I obtained these sponges from the reefs in the sea near the village Talisay," because the specimen of *Labaria* we received had, when dried, separated into two parts—a hemispherical sponge and a long tuft of broken spicules of *Euplectella*, tied at one end by a strip of a spotted silk handkerchief, which had been affixed into the base of the hemisphere! Dr. Meyer, in a letter of November 6th, 1873, says, "I wondered to hear that the largest one proved to be artificially made up; if I am not mistaken, I got still some specimens of the same kind, but they did not yet arrive in Europe." In a note just received (Jan. 21st) Dr. Meyer says:—"I looked through those bottles and dried several sponges. My Malay boy from Ternate was charged with this business, and perhaps he may have tied something together or done another mischief with them; or this may have been made by those fishermen at Talisay, I having overlooked it before I started, as I said, in a hurry."

On the Steppe-Cat of Bokhara (Chaus caudatus). By Dr. J. E. Gray, F.R.S. &c.

The Zoological Department of the British Museum has lately received the skin and skull of a *Chaus* from the steppes of Bokhara. It is very like the common jungle-cat (*Felis chaus*) from more southern Asia in the thickness and softness of the fur, in the general colouring, and in the tufts of the ears; but it differs from it in having a considerably longer tail, reaching nearly to the ground—hence its name *Chaus caudatus* in the description of it which has been read at the Zoological Society, illustrated by a beautiful figure by Mr. Wolf.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 75. MARCH 1874.

XXVII.—*On the Structure called* Eozoon canadense *in the Laurentian Limestone of Canada.* By H. J. CARTER, F.R.S. &c. (*A letter to* Professor W. KING, Sc.D., Galway.)

MY DEAR SIR,—On the 13th instant I had the pleasure to send you a "Card" acknowledging the safe arrival of your letter of the 10th inst. and specimen of Laurentian Limestone containing the so-called *Eozoon canadense*, intimating at the same time that after a few days I would answer you more at length. I now proceed to do so.

With the copy of your Papers* on the mineral origin of this formation (received on the 9th August last) and your present letter under reply, together with the decalcified slice of Laurentian Limestone (about $2 \times 2 \times \frac{1}{8}$ inch in size), which you state to be from Canada and to have been forwarded to your colleague Professor Rowney by Dr. Carpenter as a "typical specimen of *Eozoon canadense*," I also possess in my own cabinet perhaps some of the most perfectly fossilized foraminiferous structure in existence; so that, for the purpose of comparing the two, I could not be more satisfactorily provided.

That I should feel interested in the question at issue as to the identity of the Laurentian Limestone with that of foraminiferous structure may be easily conceived by the accom-

* 'Proceedings of the Royal Irish Academy,' vol. x. pp. 506–551, and 2nd series, vol. i. 1871.

panying copy of my paper on the "Form and Structure of *Operculina arabica*," read before the Bombay Branch of the Royal Asiatic Society so far back as May 1852, and published in their Journal and in the 'Annals and Magazine of Natural History' of the following year, together with many other papers subsequently published in the latter, from time to time, on the structure and adult forms of several fossilized Foraminifera, including new species. You may also thus fully understand how grateful I feel to you for having been the first to send me a specimen of the Laurentian rock, and to bring the subject of its structure and composition before me under the mineralogical point of view detailed in the papers published conjointly by yourself and Prof. Rowney, to which I have alluded.

You will also observe, by the figures in the plate attached to my paper on *Operculina*, that, at a very early period, I demonstrated the system of foraminiferous structure in a *recent Operculina* and identified it with the structure of a fossil Nummulite. How much more completely than others, a comparison of our descriptions and illustrations respectively will show, it not being my business here to lay claim to any thing beyond a position to be able to compare genuine foraminiferous structure, both living and fossilized, with the so-called *Eozoon canadense*.

Previously, however, to stating my observations in this respect, I would say a word or two on the law of form in organized beings; for this bears upon the subject.

That the "law" exists in the mineralogical as well as in the organic kingdom may be seen in the common mineral growth termed "dendrites." But, besides this familiar example, it may be observed in what are called "moss-agates," coming from the geodes of trap—that is, from a *volcanic* rock. Of the latter I possess a polished and mounted specimen, composed of opalescent chalcedony, in which there is a growth of *glauconite* that, when viewed under an inch compound power, would, by any one not acquainted with the geological facts, be termed a "branched Conferva."

Again, I possess a similarly polished and mounted specimen of green calcspar (that designated by Prof. Haughton "Hislopite"), also from a trappean geode of Western India, in which there is a growth of *glauconite* so like the remains of dead incrusted Conferva from a dirty pond that, without being acquainted with its geological position, this would also be pronounced to be Conferva in such a state fossilized.

So far the "law of form" is the same in both kingdoms, and hence the necessity of knowing this before we state confi-

dently that such and such forms are or are not organic. The mistake of identifying dendrites &c. with fossilized plants has often occurred, but not with acknowledged competent authorities.

Lastly, I possess a similar specimen of green *Heulandite* from the trap of Western India, in which the green colour is owing to the presence of a *granular* growth of *glauconite* among the translucent zeolithic mineral; and this brings me to the so-called *Eozoon canadense*, which you and your colleague Prof. Rowney conclude to be of a like nature, viz. granular serpentine in calcspar.

With your mineralogical view I have nothing to do, as it would be presumption in me to even praise such high authorities; but, from the fossilization point of view, I may be permitted to state facts which I feel able to appreciate in connexion with the subject.

Before, however, going to adult foraminiferous structure for comparison, it is desirable to premise its primary, which is its elementary, form.

Thus the assumed ovum of a foraminiferous animal is soft, spherical, filled with granuliferous sarcode, and nucleated while in the chambers of the adult living animal. After this, on approaching the embryonal state, the capsule becomes calcareous and pierced all round with minute apertures, save at one point, where there is a large one, from which issues, in the living and active condition, the internal sarcode in the form of a short cord terminated by a reticulated lash of filaments (pseudopodia) of different lengths, which are ever changing in shape (*Amœba*-like) as they are put forth in search of food &c. The calcareous covering then becomes thickened, and the "apertures" elongated into tubes which, in juxtaposition, descend perpendicularly through the crust thus formed, and keep up a connexion between the exterior and interior of the embryo.

This is the elementary form or first chamber of a foramini ferous animal; and a repetition of it, produced by the sarcode which issues from the large aperture, thus goes on stoloniferously producing chamber after chamber, of the shape peculiar to the individual, until the increments thus produced at last arrive at the ultimate form of the species.

The soft ovum can only be seen in the recent animal; but the spherical embryos, both in my specimens of *recent Operculina arabica* and in the fossilized Nummulites &c., may be seen in abundance, not only in the chambers, but in the tubes (that is, in the branches of the stoloniferous prolongations of sarcode; for they also clothe themselves with a calcareous layer), on their way out from the chambers to the exterior.

In a specimen of *Orbitolites* which I possess the *embryos* (2 to 10 or more in most of the chambers) appear to be elliptical, almost like a *Miliola*!

Thus, as stated, the foraminiferous animal, built cell over cell, at length arrives at the specific form, whether Nummulite or Orbitoides &c., and throughout is but a repetition of the embryonal chamber modified only in shape to accord with the species. But still there are the tubuli perpendicular to the plane of growth in the crusts of the chambers respectively; there are the chambers; and in the intervals of the general structure, which are filled up with calcareous material and thus form the skeleton, is a reticulated system of canals produced by the branches of the stoloniferous sarcode, communicating in all directions with the chambers through their walls and with one another, finally opening on the exterior of the test, and in their course, as I have before stated, often presenting the spherical embryos in their transit from the chambers to the exterior; while the tubuli of the crust of the chambers, being developed with these crusts successively as they are piled upon one another, form thus a *continuous* communication, through the cavities of the chambers, between the *exterior* and *very centre* of the test.

Hence, if a section of a fossilized form be made just above or just below the chamber (that is, *outside* it), the tubuli of the upper or lower part of the crust *must be seen*; while if it be made through the chamber, then the plane of the openings inside *must be seen*. Indeed it is impossible to make a section in which they do not come into view, or to examine a piece not larger than a small pin's head without seeing them; so that to pretend to identify the acicular structure sometimes observed to be standing perpendicularly on, but much more frequently *parallel* with, the surface of the grains of serpentine in the Laurentian Limestone (which grains have been viewed as the *casts* of the chambers of a foraminiferous animal) with these tubuli, that always run *directly* to the chamber, and should be thus seen in almost every atom of foraminiferous structure, seems to me to be nonsense*.

Nothing can be clearer than all that I have above stated of foraminiferous structure, as seen under an inch-focus compound power in my infiltrated specimens of *Nummulites*, *Orbitoides*, &c. from the Eocene formation of Western India.

But in vain do we seek in the so-called *Eozoon canadense* for the unvarying perpendicular tubuli, the *sine quâ non* of

* For good figures of this acicular structure, see Prof. King and Rowney's paper, read 12th July, 1869, Transactions of Royal Irish Academy, vol. x. p. 506, pls. i. to iv. figs. 1 to 6 & 10A *x* respectively.

foraminiferous structure. In vain do we look for that regularity of chamber-formation which, in the amorphous growth assigned to the so-called *Eozoon*, might be equally well assumed to be identical with the heterogeneous mass of chambers on each side of the central plane of *Orbitoides dispansa*, accompanied by the transverse bars of stoloniferous structure uniting one chamber to the other. In short, in vain do we look for the casts of true foraminiferous chambers at all in the grains of serpentine; they, for the most part, are not subglobular, but subprismatic.

With such deficiencies I am at a loss to conceive how the so-called *Eozoon canadense* can be identified with foraminiferous structure, except by the wildest conjecture; and then such identification no longer becomes of any scientific value.

Having examined the slice of Laurentian Limestone which you have so courteously submitted to me in thick and thin polished sections mounted in Canada balsam, by transmitted and also by reflected light, also the surface of the "decalcified" slice as it came from you, in all directions with ¼- and 1-inch focus compound powers respectively, I must unhesitatingly declare that it presents no foraminiferous structure anywhere. Nor does its structure bear so much resemblance to that of a foraminiferous test as the legs of a table to those of a quadruped; while if such be the grounds on which geological inferences are established, the sooner they are abandoned the better for geology, the worse for sensationalism!

The contents of this letter are open to no controversy. My knowledge of foraminiferous structure has been obtained step by step, beginning with the recent and then going to the fossilized forms, making and mounting my own sections, from which afterwards my illustrations and descriptions have been taken. If others who have pursued a similar course of instruction differ from me in what I have above stated, the question can only be decided by a third party, not on verbal arguments alone, but on a comparison of the actual specimens, as prolonged disputation, in matters of opinion, soon disgusts every body but the combatants, and can end in nothing but a fearful waste of time that might be better employed. The accompanying slide I must ask you kindly to return at your convenience, as, you will admit, such specimens of foraminiferous structure are not so plentiful as Laurentian Limestone!

I am, dear Sir,
Yours very truly,
H. J. Carter.

"The Cottage,"
Budleigh-Salterton, Devon,
29th December 1878.

XXVIII.—*Observations on* Chætetes tumidus, *Phillips*. By R. Etheridge, Jun., F.G.S.

[Plate XI. figs. 1–3.]

Chætetes tumidus was first described by Prof. Phillips in 1836 under the name of *Calamopora tumida** ; but although several figures were given, a very limited description was appended. As *Favosites tumida* both Portlock † and M'Coy ‡ noticed this coral and gave short descriptions of it. It was also recorded under the same name in the early edition of Morris's 'Catalogue' §. In his great work the 'British Palæozoic Fossils' M'Coy added to and more clearly defined the characters of this coral as *Stenopora tumida* ‖ ; he there notices the characters of the tubes or calices, the nature of the diaphragms or tabulæ, and indicates the presence of a concave diaphragm nearly closing each of the tubular openings. Messrs. Milne-Edwards and Haime appear to have been the first to refer the *Calamopora tumida* of Phillips to the genus *Chætetes* ¶. Although they do not mention the existence of tabulæ in their description, yet such appear to be plainly indicated in figure 3 *a*, plate xlv., of their 'British Fossil Corals.' Lastly Prof. De Koninck, in a recently issued work **, has given an interesting recapitulation of the principal points in the structure and history of this species, under the name of *Monticulipora tumida*.

The majority of specimens obtained from Scotch carboniferous beds, in some of which the species is very plentiful, have the margins of the calices apparently more thickened than is generally represented, although this character is variable even on the same specimen. The calices are in places very unequally developed, giving rise to spaces every here and there more or less free from openings, or where the latter are much smaller than the generality of those on the same specimen, thus forming spots which to the naked eye appear like plain patches (Pl. XI. fig. 1, *a*). The smaller tubes are about one fourth the size of the larger. On the base of attachment of *Chætetes tumidus* the tube-openings are often of a more irregular form than on the branches, becoming oval, and the walls not

* Geol. Yorksh. vol. ii. t. 1. f. 49–57.
† Geol. Report, 1843, p. 326, pl. xxii. f. 4.
‡ Synop. Carb. Foss. Ireland, 1844, p. 193.
§ Cat. Brit. Foss. 1843, p. 37. ‖ p. 82.
¶ Polyp. Foss. Terr. Pal. 1851, p. 270; also Monog. Brit. Foss. Corals, 1852, p. 159.
** Nouv. Rech. Anim. Foss. Terr. Carb. 1872, pt. i. pp. 143–146.

so thickened. This is probably the fossil figured by Ure in his 'History of Rutherglen and E. Kilbride'*, and described by Fleming as *Cellepora Urii*†. If this is so, Ure was the first to figure *Chætetes tumidus*; and it, like many of his figures, is very faithfully drawn.

When decorticated the tube-walls of *C. tumidus* are considerably reduced in thickness, when compared with the thickened external surfaces.

Fig. 2 represents a vertical microscopic section of a portion of a branch, where in the central portion, as has been pointed out by M'Coy ‡, the tubes are vertical and abruptly diverge to the surface, where they open at right angles. The internal wall of each is circular, the external hexagonal or polygonal, becoming thinner towards the imaginary axis of the coral. The vertical portion of the tubes in a transverse section presents the appearance of an axis of cellular tissue (fig. 3).

Both M'Coy and Edwards and Haime indicate the existence of tabulæ. The former says, " diaphragms about the diameter of the tubes apart"§; the latter do not mention these structures, but they distinctly figure them ‖. On the other hand, Prof. De Koninck, in his description of *Monticulipora tumida*, states that although he had examined numerous Irish and Belgian specimens, yet he had failed to discover any trace of tabulæ (*planchers*). In fig. 3, which is a transverse section of fig. 2, the tabulæ may be distinctly seen as delicate lines in that portion of the tubes at right angles to the general axis, at which point the walls in some specimens appear to be more or less constricted.

EXPLANATION OF PLATE XI. figs. 1–3.

Fig. 1. Portion of *Chætetes tumidus*, Phil., somewhat enlarged.

Fig. 2. Vertical section of portion of another specimen, showing the central vertical and lateral horizontal portions of the tubes.

Fig. 3. Transverse section of the same, showing the tabulæ passing across the horizontal portion of the tubes, and also the central vertical tubes. Figs. 2 & 3 are considerably enlarged.

[I have to thank my friend Mr. H. M. Skae for the very careful drawings accompanying these notes.]

* Plate xx. fig. 1.
† Brit. Animals, 1828, p. 533.
‡ Brit. Pal. Foss. p. 82.
L. c. p. 83.
Monog. Brit. Foss. Corals, pl. xlv. fig. 3 *a*.

XXIX.—*Mollusca, Vermes, and Cœlenterata of the Second German North-Polar Voyage.* By Carl Möbius *.

[Plate XI. figs. 4–14.]

The region in which the invertebrate marine animals cited in the following Catalogue were collected by Dr. Pansch, between the shore line and a depth of 30 fathoms, extends from 73° 50′ to 75° 15′ N. lat. Here the animals live in a temperature which varies but little throughout the year. According to the log-book of the 'Germania,' Captain Koldeway, the daily average of the surface-temperature from the 9th of July to the 13th of September 1869, from 70° 44′ to 75° 30′ N. lat., only oscillated between 1°·62 and 1°·29 R. (=35°·64 and 34°·9 F.). Then ice was produced, beneath which, from the 3rd of October 1869 to the 21st of May 1870, a temperature of 1°·5–2° R. (=35°·4 –36°·5 F.) prevailed. Measurements of temperature down to 220 fathoms within the same latitudes between the 13th of July and the 3rd of August 1869 gave 0°·4–1°·3 R. (=32°·9–34°·92 F.).

In the year 1870 the surface temperature between 71° 20′ and 75° 26′ N. lat. from the 11th of July to the 28th of September was found to be 0°·02–4°·62 R. (=32°·045–42°·4 F.). Between 73° 11′ and 71° 30′ from the 12th of August to the 27th of September, at depths of 20–300 fathoms, 0°·7–2°·6 R. (=33°·57–37°·85 F.) were observed.

According to the log-book of the 'Hansa,' Captain Hegemann, 1°–0°·6 R. (=34°·25–33°·35 F.) were found at 20–75 fathoms, on the 14th and 15th of July, in N. lat. 74° 37′ and 74° 57′; and 1° R. (34°·25 F.) at 100 fathoms in N. lat. 73° 5′.

In his address upon the scientific results of the first German North-Polar voyage of 1868, M. von Freeden says (p. 4):— "Beyond the parallel of Jan Mayen (71° N. lat.) as far as 77° we find a great sea-surface which, from the 1st of June to the 1st of September, possesses a temperature oscillating between 0° and 2° R. (=32° and 36°·5 F.), and which is more and more filled with melting masses of ice the further west we go."

Thus, with regard to the oscillations of temperature in their medium, the marine animals of Greenland are in just as favourable a position as the animals of the tropical seas.

According to Dana's 'Classification and Geographical Distribution of the Crustacea,' 1853, p. 1483, the mean surface-temperatures of the thirty coldest and the thirty warmest consecutive days are as follows:—near

* Translated and abridged by W. S. Dallas, F.L.S., from the Report of the Voyage, vol. ii. 1873, pp. 246–261.

Venezuela and Surinam .	18°·66 & 21°·32 R. (=73°·98 & 79°·97 F.),
Bahia and Pernambuco .	18°·66 & 22°·64 R. (=73°·98 & 82°·94 F.),
Singapore	18°·66 & 23°·08 R. (=73°·98 & 83°·93 F.),
Fiji Islands	18°·66 & 23°·52 R. (=73°·98 & 84°·92 F.),
Tahiti	18°·66 & 22°·64 R. (=73°·98 & 82°·94 F.),
Manilla	20°·88 & 23°·52 R. (=78°·98 & 84°·92 F.).

From the temperature-observations made by Prof. Carl Semper in the sea surrounding the Philippines, which he has been kind enough to place at my disposal for these comparisons, I extract the following:—

On the 26th of June 1861, near Anhuplate, between 10 o'clock in the morning and 10 o'clock in the evening,

the temperature of the air varied between 20°·6 & 22°·9 R. (=78°·35 & 83°·5 F.),

the temperature of the surface varied between 21°·3 & 21°·8 R. (=79°·9 & 81°·05 F.).

At the same place on the same day the temperature at

5 fathoms was	21°·5 R. (=80°·4 F.)	at 10 A.M.
17 ,,	21°·4 R. (=80°·15 F.)	at 2·30 P.M.
22 ,,	21°·4 R. (=80°·15 F.)	at 3 P.M.
5 ,,	21°·5 R (=80°·4 F.)	at 5 P.M.

Thus, at the depths here cited, the temperature differs very little from that of the surface, just as in the northern icy sea.

I suppose that the nearly uniform temperature in which the high-northern marine animals live is one of the chief causes of the considerable size by which, according to numerous observations, they are distinguished from individuals of the same species in temperate regions; for, at the bottom of the icy sea, species which from their nature can thrive in a low temperature are but little if at all exposed to those disturbances which the greater oscillations of temperature produce in the vital conditions of the animals of more temperate seas. The organs can consequently perform their functions in a more uniform manner (so far as these are dependent on temperature) than in individuals of the same species which inhabit, for example, the middle and higher regions of the North Sea and the Baltic, where the differences between the lowest and highest temperatures of the water amount to 10°–15° R. (=22°·5–33°·75 F.), or sometimes even more, as has been ascertained by H. A. Meyer * for various points in the western basin of the Baltic, and by myself for two places in the North Sea off the German coast †.

* 'Untersuchungen über physikalische Verhältnisse des westlichen Theils der Ostsee' (Kiel, 1871), § 27.

† Zeitschrift für wissenschaftliche Zoologie, Band xxi. 1871, pp. 301, 302.

MOLLUSCA.

Gasteropoda.

1. *Chiton albus*, Linn. Length 15, breadth 8 millims.
Distr. Spitzbergen to the Cattegat and Britain, Massachusetts (*Gould, Binney*). Down to 550 fathoms.

2. *Lepeta cæca*, Müll. Length 11, breadth 8, height 5 millims.
Walrus Island, 25 fathoms.
Distr. Circumpolar; Sitka, North Japan (*Schrenck*), Spitzbergen to the Cattegat and Britain.

3. *Trochus grœnlandicus*, Chemn. Length 13, breadth 15 millims.
Sabine Island, Jackson Island, North Shannon Island, Germania Harbour; 2–30 fathoms.
Distr. Labrador to Massachusetts; White Sea to the Cattegat and Britain.

4. *Trochus helicinus*, Fab. Length 15, breadth 20 millims.
Sabine Island, Jackson Island, North Shannon Island; Walrus Island; 4–27 fathoms.
Distr. Circumpolar; Massachusetts, Japanese seas, Norway to the Cattegat and Britain.

5. *Pleurotoma pyramidalis*, Ström. Length 12, breadth 6 millims.
Sabine Island, Jackson Island, Shannon Island; 4–30 fathoms.
Distr. Greenland to Massachusetts, Spitzbergen to Norway (Bergen).

6. *Fusus propinquus*, Alder. Length 72, breadth 33 millims.
Sabine Island, Clavering Island, Germania Harbour; 2–20 fathoms.
Distr. Russian arctic coast to the Cattegat and Ireland.

7. *Buccinum undatum*, Linn. Length 42, breadth 30 millims.
Jackson Island, Clavering Island; 4 fathoms.
Distr. Circumpolar; European and North-American coasts of the North Atlantic, Mediterranean, Sea of Ochotsk.

8. *Scalaria grœnlandica*, Chemn. Length 30 millims.
North Shannon Island, 30 fathoms.
Distr. Arctic Ocean, Norway to Bergen.

9. *Natica clausa*, Brod. & Sow. Length 29, breadth 20 millims.
North Shannon Island, Sabine Island, Jackson Island, Clavering shore; 30 fathoms.
Distr. Circumpolar; Japanese sea, Finmark.

10. *Cylichna cylindracea*, Penn. Length 19, breadth 4·5 millims.

Jackson Island, 4 fathoms.

Distr. Finmark, Canaries, Mediterranean; 3–160 fathoms.

11. *Clione limacina*, Phips. Length 36 millims.

Distr. West Greenland, Massachusetts.

LAMELLIBRANCHIA.

1. *Modiolaria discors*, Linn. Length 26, height 16, breadth 11 millims.

Shannon, Sabine, Clavering, and Jackson islands; 4–30 fathoms.

Distr. Circumpolar; North-east of America, north Japanese sea, Mediterranean, North Sea, Western Baltic.

2. *Cardium grœnlandicum*, Chemn. Length 70 millims.

Distr. West Greenland, Massachusetts, Behring's Straits.

3. *Astarte borealis*, Chemn. (*A. arctica*, Gould). Length 33–35, height 27, breadth 7–10 millims.

Shannon, Sabine, Clavering, and Jackson islands; 4–10 fathoms.

Distr. Arctic seas, from Behring's Straits to Lapland, Norway, Baltic to Bornholm.

4. *Astarte sulcata*, Da Costa. Length 25, height 18, breadth 10 millims.

Distr. Circumpolar; Sea of Ochotsk, Canaries, North-eastern America, bays of Kiel and Flensburg.

5. *Astarte compressa*, Mont. Length 14, height 12, breadth 7·5 millims.

Jackson Island.

Distr. Arctic seas, North-eastern America, Spitzbergen, Norway, Britain, Kiel Bay.

6. *Astarte crebricostata*, Forbes. Length 28, height 22, breadth 13 millims.

Shannon Island, 30 fathoms.

Distr. West Greenland, Norway, North-eastern America.

7. *Venus astartoides*, Beck. Length 16, height 12, breadth 7 millims.

Shannon Island, Jackson Island; 4–30 fathoms.

Distr. West Greenland, Massachusetts, seas of Ochotsk and Japan.

8. *Mya truncata*, Linn.

Sabine Island, 10–20 fathoms.

Distr. Circumpolar; Sea of Ochotsk, North-eastern America, Britain, Bay of Biscay, Norway, Western Baltic.

9. *Saxicava rugosa*, Linn. Length 43, height 22 millims.

Shannon Island, 30 fathoms.

Distr. Circumpolar; Japanese and Chinese seas, North-

eastern America, Sitka, Mediterranean, Canaries, North Sea, Western Baltic.

Brachiopoda.

1. *Terebratula psittacea*, Gmel. Length 21, breadth 22, height 15 millims.
   Jackson Island.
   Distr. West Greenland, Massachusetts, Spitzbergen, Finmark.
2. *Terebratula cranium*, Müll. Length 16, breadth 11, height 11 millims.
   Shannon Island, 30 fathoms.
   Distr. Norway, Shetland Isles, Finmark to the Cattegat.

VERMES.

Annelides.

1. *Polynoë cirrosa*, Pall. Length 47, breadth 10 millims.
   Sabine Island.
   Distr. Finmark to the Cattegat, Britain, West Greenland, Spitzbergen; 3–120 fathoms.
2. *Polynoë cirrata*, Pall. Length 33, breadth 10 millims.
   Sabine Island, Clavering Straits; 4–12 fathoms.
   Distr. Circumpolar; Baltic to Sitka.
3. *Nereis diversicolor*, Müll.
   Shannon Island.
   Distr. Norway, North Sea, Baltic.
4. *Nereis pelagica*, Linn. Length 75, breadth in front 65 millims.
   Distr. Western Baltic to Finmark, Spitzbergen, Iceland, West Greenland.

5. Leipoceras, g. n.

Head without tentacles and tentacular cirri; fifth body-segment longer than the preceding and following segments, bearing on each side *a comb-like series of thick setæ* (Pl. XI. fig. 11); branchiæ linguliform, on both sides of the back of the segments.

Leipoceras uviferum, sp. n. Pl. XI. figs. 4–14.

A spirally rolled worm, 38 millims. long, 1·5 millim. broad in front and 1·2 millim. behind. Seventy segments, the posterior extremity injured. Fore body concave above, arched beneath; from the eleventh segment onwards the concavity disappears and the back also is arched, so that the body then

becomes nearly cylindrical. Head somewhat narrowed in front (Pl. XI. fig. 4). In front, on the cephalic lobes, there are two small round projections. Two eyes, on two flat cushions, which become fused together behind and run out into a single flat and narrow cushion, extending as far as the fourth body-segment.

Buccal orifice bounded to the right and left by pad-like lips, which unite below at an acute angle (fig. 5).

The first body-segment bears two tufts of setæ, which are smaller than those on the three following segments. The setæ of the upper tufts of the fore body (in front of the fifth segment) are subulate, those of the lower tufts narrowly lanceolate (figs. 9 & 10). On the fifth segment there is, both above and below the thick setæ, a small tuft of fine setæ (figs. 11 & 12).

From the sixth segment onwards there are on the ventral surface uncini, five or six in each row; they are slightly sigmoid and two-pointed (fig. 8). The setæ of the dorsal surface stand upon the anterior surface of small tubercles; and behind these are the branchiæ, which only become long enough to be called linguliform from the tenth segment onwards. They are longest on the seventeenth segment. In front of the longer branchiæ the setigerous tubercles are smaller than before the shorter ones. Each branchia contains a simple vascular loop without anastomoses.

From the eighteenth segment onwards there are on the sides of the body, lower down than the branchiæ, and at the boundary between each two segments, some tubercles, which posteriorly become racemose. These are egg-racemes or external ovaries (figs. 6 & 7), with ova not yet fully developed (fig. 14). On the inner surface of the body-wall there are elongated ova (fig. 13) in the same segments of the body which bear external ovaries.

Unfortunately only one example of this worm was found. It is brownish yellow (in spirit), and has on the middle of the hinder part of the back two brown longitudinal lines, which are thickened parts of the cuticle.

I place this new genus among the *Spioidei*. It has no cephalic appendages like *Prionospio*, Malmgr., possesses linguliform branchiæ with a simple vascular loop, like *Spio*, Fab., and has a comb-like series of thick setæ in the fifth body-segment, like *Polydora*, Busk (*Leucodore*, Johnst.).

The formation of the ova in external ovaries is a phenomenon not previously observed among the Annelides.

6. *Scoloplos armiger*, Müll.

Sabine Island.

Distr. Spitzbergen to the Baltic, north of France.

7. *Travisia Forbesii*, Johnst. Length 40 millims., thickness 6 millims. in the middle.
   Sabine Island.
   Distr. West Greenland, Spitzbergen to the Western Baltic, Scotland.
8. *Scolibregma inflatum*, Rathke. Length 50 millims.
   Distr. Cattegat to Spitzbergen, Scotland, West Greenland; 5–280 fathoms.
9. *Thelepus circinatus*, Fab.
   Sabine Island, 20 fathoms.
   Distr. Mediterranean, Britain, Cattegat to Finmark, Iceland, Spitzbergen, West Greenland.
10. *Protula media*, Stimps.
   Sabine Island, 20 fathoms. (Prof. Möbius gives a description and figures of this species.)
   Distr. Grand Manan (45° N. lat.).
11. *Serpula spirorbis*, Müll. Diameter 3 millims.
   Shannon Island.
   Distr. West Greenland, North Sea, Baltic.
12. *Chione infundibuliformis*, Kröy.
   Sabine Island, 2½ fathoms.
   Distr. Finmark, Spitzbergen, West Greenland; 15–40 fathoms.

Gephyrea.

Priapulus caudatus, Lamk.

Turbellaria.

Polystemma roseum, Müll. Length 50–53, breadth 8, height 4 millims. (in spirit).
   Clavering Straits, 15 fathoms.
   Distr. Norway, the Sound, Western Baltic.

Nematodes.

Ascaris mystax, Rud. (From the intestine of *Canis lagopus*.)

Cestodes.

1. *Tetrabothrium anthocephalum*, Rud. (From the intestine of *Cystophora cristata*.)
2. *Tænia expansa*, Rud. (From the intestine of *Ovibos moschatus*.)
3. *Tænia cœnurus*, Küch. (From the intestine of *Canis lagopus*; described.)

ECHINODERMATA.

HOLOTHURIOIDEA.

Myriotrochus Rinkii, Steenstr. Length 45, thickness 8 millims.
Germania Harbour, 2 fathoms.
Distr. West Greenland, down to 10 fathoms.

ECHINOIDEA.

Echinus dröbachiensis, Müll.
Clavering Island, 15 fathoms.
Distr. Circumpolar; Newfoundland, Bay of Georgia, White Sea, Kamtschatka, Sea of Ochotsk, North Cape to the Sound, Britain.

ASTEROIDEA.

1. *Asteracanthion albulus*, Stimps.
Sabine Island.
Distr. West Greenland, Grand Manan.
2. *Ophioglypha robusta*, Ayres. 27 fathoms.
Distr. West Greenland, Massachusetts, Iceland, Spitzbergen, Norway to the Sound, Britain.
3. *Ophiocten sericeum*, Forbes. 26 fathoms.
Distr. East Greenland, West Greenland, Spitzbergen.
4. *Asterophyton eucnemis*, Müll. & Tr.
Distr. West Greenland, down to 1000 fathoms.

CŒLENTERATA.

1. *Actinia nodosa*, Fab.
2. *Briareum grandiflorum*, Sars.
Distr. Öxfjord in Finmark, Arendal.

EXPLANATION OF PLATE XI. figs. 4–14.

Leipoceras uviferum.

Fig. 4. Head and fore body from above ($\frac{12}{1}$).
Fig. 5. Head from below ($\frac{12}{1}$).
Fig. 6. Nineteenth and twentieth segments, right side, with the commencement of the external ovaries.
Fig. 7. Forty-second and forty-third segments, with the external ovaries further developed.
Fig. 8. Uncini of the fifteenth segment, from below ($\frac{40}{1}$).
Fig. 9. Seta of an upper tuft in the fore body.
Fig. 10. Seta of a lower tuft in the fore body.
Fig. 11. Thick setæ of the fifth segment.
Fig. 12. Inferior fine setæ of the fifth segment.
Fig. 13. Ovum from the body-cavity of the hinder body ($\frac{275}{1}$).
Fig. 14. Ovum from an external ovary ($\frac{275}{1}$).

XXX.—*On the Invertebrate Marine Fauna and Fishes of St. Andrews.* By W. C. M'Intosh.

[Continued from p. 145.]

Subkingdom *CŒLENTERATA.*

Class HYDROZOA.

The Hydroid Zoophytes of St. Andrews are chiefly procured from the deep water of the bay, though a few appear between tide-marks. Many are found in great profusion. Contrasted with the southern shores, as at Devon and Cornwall *, the majority of the Hydroids are equally common in both localities; some occur more frequently in the one than in the other, while a third series is more characteristic of each area. Thus *Sertularella rugosa*, *Sertularia cupressina*, *Thuiaria thuja*, and *Halecium muricatum* appear to be more abundant at St. Andrews than in the south; on the other hand, *Sertularia argentea* and *Obelia dichotoma* are probably more plentiful in the latter, together with the appearance of *Tubularia* at the extreme margin of low water. The characteristic forms in the south are *Corymorpha nutans*, *Aglaophenia pluma*, *A. pennatula*, *Ophiodes mirabilis*, *Diphasia pinnata*, and an abundance of the species of *Plumularia*. At St. Andrews *Sertularia filicula*, *S. fusca*, *Tubularia coronata*, *Cuspidella humilis*, and *Halecium labrosum* afford distinguishing features. Moreover, instead of the tufted *Clava squamata*, so common on the littoral Fuci of the western coast, we have *C. multicornis* at St. Andrews on the under surface of stones; the splendid *Corymorpha nutans* of the sandy voes, and the rich tufts of littoral Corynidæ and *Gonothyræa* of the Zetlandic region, are likewise wholly absent. Amongst the Hydromedusæ, *Sarsia prolifera*, Forbes, occurs occasionally, and *Thaumantias pilosella*, Forbes, in great abundance on the surface of the bay in autumn.

The habit of the zoophytes affords many interesting facts, especially in regard to the profusion of parasitic structures. The roots of the polyparies spring from diverse shells, stones, crabs, submerged sticks and branches. One of the most curious examples found by the fishermen in the bay consisted of a stout branch of a thorn-tree, about four feet in height, which had large specimens of *Balanus Hameri* and Ascidians clustered like living fruit on the main trunk and branches,

* J. & R. Q. Couch, in their 'Cornish Fauna;' the elaborate catalogue of the Rev. T. Hincks in the 'Ann. & Mag. Nat. Hist.' 1861-62; and Mr. Parfitt's Devonshire Catalogue published in 1866.

and lobulated and club-shaped masses of *Alcyonium* coating the more slender twigs and overrunning the neighbouring Cirripedes; while *Obelia* fringed most of the branches, here and there giving place to the shorter coating of *Sertularia*, stunted *Tubularia*, or the downy *Clytia*. Hosts of other animals occurred on the congenial site—tubes of *Thelepus* and *Serpula*, *Anomia*, *Saxicava*, *Xylophaga*, *Lepralia*, *Cellepora*, and *Tubulipora* representing the sedentary forms, sessile-eyed Crustaceans and Starfishes the free. Indeed the production formed a compendium of marine zoology that took much time and trouble to investigate. The rapidity of growth of the larger specimens (the *Balani* being as large as walnuts) was shown by the condition of the wood and bark, and the presence of many delicate twigs. This is also seen in the case of slender branches of the common currant-bushes, which are brought to land in good preservation yet densely fringed with *Obelia longissima* and studded with large ascidians. The zoophytes themselves are subject to many parasitic inroads from sponges, Foraminifera, other zoophytes, various Polyzoa, Ascidians, Nudibranchs and their ova, young mussels and *Anomia*, the ova of *Pycnogonum*, Annelids and their tubes (hyaline, gritty, and calcareous), and minute Cirripedes.

In the following list the arrangement and nomenclature of the Rev. T. Hincks in his recent beautiful work on the Hydroida is adopted.

Order I. HYDROIDA.

Suborder I. **ATHECATA.**

Fam. 1. **Clavidæ.**

Genus CLAVA, Gmelin.

Clava multicornis, Forskål; Hincks, Brit. Hydroid Zoophytes, vol. i. p. 2.

Frequent under stones in pools near low-water mark, and growing on *Cynthia grossularia* under the cavern roofs; but it is not seen on the littoral seaweeds, as is *Clava squamata* on the shores of the Hebrides and the western and other coasts of Scotland. The tentacles show a slightly enlarged sucker-tip.

Fam. 2. **Hydractiniidæ.**

Genus HYDRACTINIA, Van Beneden.

Hydractinia echinata, Fleming; Hincks, Brit. H. Z. vol. i. p. 23.

Abundant on *Fusus islandicus*, *Natica*, and other univalve

shells cast on shore after storms. The outer lip in the shells inhabited by hermit crabs is frequently prolonged into a horny membrane, as mentioned by Dr. Johnston.

Fam. 9. Eudendriidæ.

Genus Eudendrium, Ehrenberg.

Eudendrium rameum, Pallas; Hincks, Brit. H. Z. vol. i. p. 80.

Plentiful in the deep water of the bay, attached to shells and masses of *Balani* and *Serpulæ*. A fine specimen measured 9 inches high, and the breadth of the branched portion was 8 inches.

Eudendrium capillare, Alder; Hincks, Brit. H. Z. vol. i. p. 84.

Fine tufts are occasionally found on the stems of *Antennularia ramosa*, interwoven with other zoophytes, from deep water. The specimens had no short branches; all were much elongated, and the polyps terminal. Some slight rings existed here and there on the main stems at the base; those at the origin of each branch are very distinct.

Fam. 11. Tubulariidæ.

Genus Tubularia, Linnæus.

Tubularia indivisa, L.; Hincks, Brit. H. Z. vol. i. p. 115.

Common in deep water. One of the largest specimens springs from an agglutinated basis of the valves of *Pecten opercularis* and gravel, eight inches in diameter, and the gigantic tuft had tubes 11 inches in height. It also sometimes fixes the valves of a living *Mytilus modiolus* so as almost to prevent motion.

Tubularia coronata, Abildgaard; Hincks, Brit. H. Z. vol. i. p. 119.

Abundant in deep water. I am obliged to Prof. Allman for discriminating wrinkled specimens of this species, in 1863.

Suborder II. THECAPHORA.

Fam. 1. Campanulariidæ.

Genus Clytia, Lamouroux.

Clytia Johnstoni, Alder; Hincks, Brit. H. Z. vol. i. p. 143.

Abundant on *Alcyonidium hirsutum* and seaweeds in the

pools near low-water mark, as well as coating the stems of *Laminariæ* with a hairy fringe fully half an inch in height. In a fine example of the latter many of the stems possess one or two branches, and the gonothecæ here and there have a stalk composed of several rings.

Genus Obelia, Péron & Lesueur.

Obelia geniculata, L.; Hincks, Brit. H. Z. vol. i. p. 149.

Common on laminarian blades thrown on the West Sands after storms, forming a miniature cover amidst which many Nudibranchs find food and shelter. It occurs plentifully also on *Halidrys siliquosa* and other seaweeds near low-water mark, and on crabs. In the interior of many of the gonothecæ are the young of a Pycnogonidian.

Obelia longissima, Pallas; Hincks, Brit. H. Z. vol. i. p. 154.

Abundant in deep water. It bristles on every branch or fragment of wood which has been submerged for some weeks. It appears also in a very interesting condition in the peculiar rounded balls formed by the rolling action of the waves on the beach; these zoophytic masses are either spherical or rounded-oblong, and the fibres are firmly felted together *. In this state the present species is stripped of its minute branches, and feels bristly and crisp. The same rolled masses (also chiefly composed of an *Obelia* allied to the present form) were brought from the shore of a New-Zealand bay by Dr. Lauder Lindsay, who kindly sent them to me. They are formed in a similar manner as the well-known balls in Loch Tay, where the rolling action of the waves produces perfectly round masses, often as large as a spherical shot of thirty or forty pounds, composed of the linear leaves of the larches and pines which shade its margin. Miss M'Leod, of Paible, brought me spherical masses of a similar description from a freshwater lake in South Uist, the species in this case, according to Prof. Dickie, being *Cladophora glomerata*. *O. longissima* affords a favourite site for young mussels.

Obelia dichotoma, L.; Hincks, Brit. H. Z. vol. i. p. 156.

Not common; parasitical upon a piece of seaweed from the laminarian region, and reaching about 3 inches high.

* One of these masses so closely resembled the chignon lately in vogue that it was secretly used by a patient for this purpose, and I learned that it was only the disagreeable abundance of sand in its tissue that saved it from further duty in this respect.

Genus CAMPANULARIA, Lamarck.

Campanularia volubilis, L.; Hincks, Brit. H. Z. vol. i. p. 160.

Common; on crabs, the stems of *Sertularia argentea* and other zoophytes from deep water. It is a smaller and more delicate species than *C. verticillata*. The shape of the cup and the very distinct "spherical ring" below distinguish it when the gonothecæ are absent.

Campanularia Hincksii, Alder; Hincks, Brit. H. Z. vol. i. p. 162.

Occasionally found on the stems of *Antennularia antennina* from the deep water of the bay. This species presents certain variations. In some the stem is nearly smooth from the base to the cup, where there are only a few slight twists; in others there are several distinct though irregular rings or twists at the base, a few about the middle of the stem, and others at the base of the calycle; in almost all there is one very distinct ring at the base of the latter, as Mr. Alder shows in his figure *. There is also a peculiar hollow at the base of the calycle; but this cannot be called a ring.

Campanularia verticillata, L.; Hincks, Brit. H. Z. vol. i. p. 167.

Common in deep water. Many specimens were also found in the stomach of *Echinus esculentus* from the laminarian zone.

Campanularia flexuosa, Hincks, Brit. H. Z. vol. i. p. 168.

Not uncommon on the under surfaces of stones near low-water mark. The peculiar zigzag form of the stem, with the arms of the forks tending in opposite directions, together with the short, broad, and smooth-edged hydrothecæ, are characteristic. The long pedicels of the hydrothecæ had their central smooth portions peculiarly flattened out, so as almost to assume a fusiform aspect.

Campanularia raridentata, Alder; Hincks, Brit. H. Z. vol. i. p. 176.

Occasionally found on *Antennularia antennina* and other zoophytes from the coralline ground. The form agrees in most respects with the published description. The calycle is very narrow and deep, with six to eight large teeth on the margin;

* Catalogue of the Zoophytes of Northumberland and Durham, pl. iii. fig. 0.

stalk rather slender (much more so than in *Clytia Johnstoni*), with several distinct rings below the cup, and many less distinct towards the base. The peculiar slenderness of the stalk, the length of the cup, and the small number of teeth are the characteristic features. Specimens which resemble *Clytia Johnstoni* occasionally grow in proximity; and some intermediate forms occur.

Genus GONOTHYRÆA, Allman.

Gonothyræa Lovéni, Allman; Hincks, Brit. H. Z. vol. i. p. 181.

Abundant on *Sertularia abietina* and *Diphasia rosacea* from deep water. The exceeding delicacy of the free margins of the hydrothecæ, even in good spirit-preparations, renders it difficult to say whether they are (or were) notched or smooth. It was only by a comparison of observations on many examples that the peculiar crenations were understood, as none showed more than a few, and the majority none at all. The appearance of the gonothecæ, however, is characteristic.

Gonothyræa gracilis, Sars; Hincks, Brit. H. Z. vol. i. p. 183.

Plentiful on *Tubularia indivisa*, from deep water, amongst *Clytia Johnstoni*, on the tests of *Ascidia sordida*, on *Scalpellum vulgare*, *Stenorhynchus rostratus*, and *Cellepora pumicosa*. The capsules are large, translucent, and borne on a ringed stalk. Growing as this did amongst *C. Johnstoni*, it at first seemed to be a branched variety of the latter; but the peculiar nature of the branching and the structure of the gonothecæ, which were chiefly borne on the stems, distinguished it on closer scrutiny. Moreover the hydrothecæ of this species, contrasted with *C. Johnstoni*, are much larger and deeper.

Fam. 2. **Campanulinidæ.**

Genus OPERCULARELLA, Hincks.

Opercularella lacerata, Johnston; Hincks, Brit. H. Z. vol. i. p. 194.

Abundant on the stems of *Plumularia pinnata*, *Obelia longissima*, and other zoophytes, and amongst *Clytia Johnstoni* on the stems of *Laminariæ*; Prof. John Reid also found it on *Scrupocellaria scruposa*. This species presents two well-marked varieties, which occur together on the same stem: (*a*) hydrothecæ on simple stalks of variable length, viz. from three to nine rings; and (*b*) branched stems of some height, with the alternate stalks of the hydrothecæ composed of from

six to more than a dozen rings. Moreover, in these branched forms it is not uncommon to see more than one pedicel arise at the same fork, so as to cause the observer to fancy he is viewing the *Campanulina turrita* of Prof. Wyville Thomson; only the hydrothecæ are much shorter in proportion to the length of the teeth. Some examples on a laminarian stalk had very long stems. The hydrothecæ in all very closely resembled those on Dr. Allman's *Campanulina repens* (Hincks, Brit. H. Z. vol. i. p. 189, pl. xxxviii. fig. 1). No gonothecæ were observed.

Fam. 4. **Lafoëidæ.**

Genus Lafoëa, Lamouroux.

Lafoëa dumosa, Fleming; Hincks, Brit. H. Z. vol. i. p. 200.

Common on various zoophytes from deep water. Some varieties of this species have short stalks of one or two whorls supporting the hydrothecæ; but they are not quite so long as those described under *L. fruticosa*, Sars, and the intermediate forms show that they are to be referred to the present species.

Lafoëa fruticosa, Sars; Hincks, Brit. H. Z. vol. i. p. 203.

Occasionally on zoophytes from deep water, especially *Sertularia filicula*. The pedicels of the hydrothecæ have from three to five rings.

Besides the above there are several microscopic forms closely allied, which creep along the stems of various zoophytes. A sessile form is common on *Crisia eburnea*, and a stalked species on *Scrupocellaria scruposa*.

Genus Calycella, Hincks.

Calycella syringa, L.; Hincks, Brit. H. Z. vol. i. p. 206.

Abundant on the stems of *Hydrallmania falcata* and other zoophytes from deep water.

Genus Cuspidella, Hincks.

Cuspidella humilis, Hincks, Brit. H. Z. vol. i. p. 209.

Not uncommon on the tests of *Ascidia sordida*, and on the valves of *Psammobia* and other shells, from deep water. The tests of Ascidians are the seat of a reticulated growth with numerous minute club-shaped processes rising from the creeping stem which is associated with *C. humilis*.

Genus Filellum, Hincks.

Filellum serpens, Hassall; Hincks, Brit. H. Z. vol. i. p. 214.

Abundant on the stems of *Sertularia abietina* and *H. falcata* from deep water.

Fam. 6. **Coppiniidæ.**

Genus Coppinia, Hassall.

Coppinia arcta, Dalyell; Hincks, Brit. H. Z. vol. i. p. 218.

Common on the stems and branches of *Sertularia abietina* and *Hydrallmania falcata.*

Fam. 7. **Haleciidæ.**

Genus Halecium, Oken.

Halecium halecinum, L.; Hincks, Brit. H. Z. vol. i. p. 221.

Plentiful in deep water, though somewhat less common than the next species. Young specimens under an inch in height sometimes occur, which in spirit quite agree with the Rev. A. M. Norman's description of *H. sessile* (Hincks, *l. c.* p. 229, pl. xliv. fig. 2), with, of course, the exception of the polyps. In these cases the hydrothecæ do not seem to be fully developed; but they show the row of dots below the margin. Specimens are also seen in which one or two of the hydrothecæ are better developed at the base of the stem, while all the rest are in the condition described by Mr. Norman. It would appear to be doubtful if the mere elongation of the polyps would constitute specific distinction, any more than the fact that the branches are not in the same plane. Some are slightly ringed.

Halecium muricatum, Ellis and Solander; Hincks, Brit. H. Z. vol. i. p. 223.

This is the common *Halecium* from the deep water of the bay. Most of the specimens show a ring or two on the stem above the calycles.

Halecium Beanii, Johnston; Hincks, Brit. H. Z. vol. i. p. 224.

Not uncommon in the coralline region, attached to other zoophytes and to the tests of Ascidians. Young examples have piles of little cups on the hydrothecæ like those on the beautiful southern *H. tenellum*, Hincks.

Halecium labrosum, Alder; Hincks, Brit. H. Z. vol. i. p. 225.

From the deep-sea lines of the fishermen. Rather rare.

Fam. 8. Sertulariidæ.

Genus SERTULARELLA, Gray.

Sertularella polyzonias, L.; Hincks, Brit. H. Z. vol. i. p. 235.

Abundant in the deep water of the bay, generally attached to the roots of other corallines. All the specimens seem true to the description of the species; at least there is no tendency to wrinkles in the hydrothecæ so far as examined.

Sertularella rugosa, L.; Hincks, Brit. H. Z. vol. i. p. 241.

Common; under stones near low-water mark, and thence to deep water, on seaweeds, *Flustra foliacea*, &c.

Sertularella tenella, Alder; Hincks, Brit. H. Z. vol. i. p. 242.

In profusion on *Sertularia abietina* and other zoophytes from the coralline ground.

Genus DIPHASIA, Agassiz.

Diphasia rosacea, L.; Hincks, Brit. H. Z. vol. i. p. 245.

Abundant in deep water on other corallines, such as *Hydrallmania falcata*, *Thuiaria thuja*, *Halecium*, &c. The specimens are large and luxuriant. Mr. Hincks is right in stating that the male gonothecæ have eight longitudinal ridges, and not six as Dr. Allman says.

Diphasia tamarisca, L.; Hincks, Brit. H. Z. vol. i. p. 254.

Not uncommon in deep water attached to shells and stones.

Genus SERTULARIA, Linn.

Sertularia pumila, L.; Hincks, Brit. H. Z. vol. i. p. 260.

This is the common Sertularian under stones in rock-pools at and near low-water mark at St. Andrews; but it is less luxuriant than on the Fuci of the western coasts. It forms a miniature forest on the under surface of the stones in quiet places, and is a favourite haunt of *Eolis viridis* and other Nudibranchs. It presents the peculiarity in such situations that the stem is not always contracted above the hydrothecæ, but not unfrequently these follow each other without the constriction. In some preserved specimens the hydrothecæ contained a number of large nucleated cells, having apparently a thickened and regularly crenated cell-wall; these cells varied in size; and some also occurred in the centre of the

Sertularia operculata, L.; Hincks, Brit. H. Z. vol. i. p. 263.

Not uncommon; on seaweeds at and beyond low-water mark, but chiefly procured on the West Sands after storms. Its comparative scarcity is in marked contrast with its profusion on our western coasts, where almost every laminarian root and stalk are clothed with dense tufts.

Sertularia filicula, Ellis and Solander; Hincks, Brit. H. Z. vol. i. p. 264.

This, perhaps, is the most abundant Sertularian next to *S. abietina* from deep water. Dried specimens, when carefully laid out, show a somewhat rectangular arrangement of their terminal branches. Good examples have also been procured from the stomach of the cod.

Sertularia abietina, L.; Hincks, Brit. H. Z. vol. i. p. 266.

Very common; and occasionally reaching the height of 9 inches; fine tufts occur on *Mytilus modiolus*. This species is a favourite seat of many parasites, such as other hydroid zoophytes, calcareous corallines, *Spirorbis*, *Alcyonidium*, *Coppinia*, &c. From its attachment to living mollusca (*Anomia* and others) it is not unfrequently swallowed by the cod.

Sertularia argentea, Ellis and Solander; Hincks, Brit. H. Z. vol. i. p. 268.

Not common; from the deep-sea lines of the fishermen. This seems to be a form more characteristic of our southern shores.

Sertularia cupressina, L.; Hincks, Brit. H. Z. vol. i. p. 270.

Very plentiful in the coralline region, and sometimes reaching the length of 18 inches. Besides the ordinary form there are two branched varieties. In the first, numerous secondary polyparies spring from the ordinary dichotomous branches, each twig so burdened being very little thicker than the ordinary forms, and bearing in the usual manner for some distance the hydrothecæ, which gradually become obsolete; this secondary trunk assumes considerable dimensions, with jointed stem and dichotomous branches, like an independent specimen. In the other variety the main stem itself splits into two divisions, or the secondary trunks throughout are directly connected therewith.

Sertularia fusca, Johnst.; Hincks, Brit. H. Z. vol. i. p. 272.

A single fine specimen only has yet been procured, in the

deep water of the bay. Mr. Alder correctly observes that this form leads us to *Thuiaria.*

Genus Hydrallmania, Hincks.

Hydrallmania falcata, L.; Hincks, Brit. H. Z. vol. i. p. 273.

One of the most abundant hydroid zoophytes from the coralline ground. Its form varies from the elongated spiral to the broadly branched condition, and it is frequently loaded with parasitic zoophytes, both horny and calcareous. It is also a favourite site for Nudibranchiate Mollusca and their ova, and minute Annelids construct their tubes on every convenient bough. Young specimens are plentiful also under stones between tide-marks, where their habit differs considerably from the foregoing, having the form of a simple straight pinna, generally coated with parasitic structures, both animal and vegetable.

Genus Thuiaria, Fleming.

Thuiaria thuja, L.; Hincks, Brit. H. Z. vol. i. p. 275.

Common; chiefly frequenting dead valves of *Cyprina*, *Pecten*, and *Tapes*, as well as stones, shooting its long stems upwards (occasionally to the length of 14 inches) amidst masses of the tubes of *Serpula*, *Thelepus*, and other Annelids, and patches of *Alcyonium*. In some examples a short secondary stem branches from the main trunk near the base. Parasitic upon the stems are numerous other corallines, such as *Diphasia rosacea*, which clothes anew the bare zigzag trunk with a more silky fringe than nature originally provided; rough crusts of *Cellepora* or the spreading *Alcyonium* and *Alcyonidium* entirely surround it; while occasionally a long tunnel of *Thelepus* is glued from the base to the branching portion. Now and then it occurs in the stomach of the cod.

Fam. 9. **Plumulariidæ.**

Genus Antennularia, Lamarck.

Antennularia antennina, L.; Hincks, Brit. H. Z. vol. i. p. 280.

From the deep water of the bay; common, but less so than the next species. Fine tufts reach a height of fully 11 inches. In a curious example a number of simple straight stems proceed from the upper edge of a fragment of an old trunk.

Antennularia ramosa, Lamarck; Hincks, Brit. H. Z. vol. i. p. 282.

Common in deep water, whence it is usually brought by the fishermen's lines.

Genus Plumularia, Lamarck.

Plumularia pinnata, L.; Hincks, Brit. H. Z. vol. i. p. 295.

Frequent in deep water, and often reaching the height of 7 inches. A tall variety is found in which no spines are present on the gonothecæ. It sometimes occurs on *Stenorhynchus rostratus* between tide-marks.

Plumularia catharina, Johnst.; Hincks, Brit. H. Z. vol. i. p. 299.

Common on Ascidians, tubes of *Thelepus*, and the roots of other corallines in deep water.

Plumularia frutescens, Ellis & Solander; Hincks, Brit. H. Z. vol. i. p. 307.

Occasionally thrown on the West Sands after storms, and also brought in on the deep-sea lines of the fishermen. The smaller specimens are pale. One example is 6 inches in height, and broadly branched.

Order Medusidæ.

The Medusidæ abound chiefly in autumn in the bay, the most conspicuous amongst the larger forms being *Aurelia* and *Cyanea*, the former often occurring in such numbers as to form a closely packed layer on the surface of the sea over considerable areas; and though not in the dense party-coloured masses of various species occasionally seen in the Hebrides, still they form an interesting feature. At certain points the bay in quiet weather is quite purplish with thousands, many of which are loaded with ova; and through the transparent umbrellas the abdominal feet of the parasitic Hyperidæ are observed in constant vibration. Occasionally, whether from accident or design, one specimen is found adhering to the umbrella of another, and is thus carried through the water. Moreover, on many of the stones at the East and West Rocks, near low-water mark, a "*Hydra tuba*" is found, which may be the hydroid condition of the foregoing. This pretty little white structure, developed from the ova of *Aurelia* and its allies, can be observed in all stages not only throwing out lateral buds like a *Hydra*, but by transverse fission dividing into a series of saucer-shaped bodies which ultimately assume the form of the adult *Aurelia*. This form, it is well known, formed the subject of valuable observations by the late Prof. M. Sars, and afterwards, amongst

others, by the late Dr. John Reid, who obtained his examples at St. Andrews.

On the whole we lack at St. Andrews the splendid profusion of the swimming jellies occasionally met with on our western shores, and especially in the Outer Hebrides, to which a favouring wind and tide sweep them from the warmer area of the Gulf-stream beyond, in company with *Ianthina* and the Pteropods. Amongst these the strange and beautifully tinted *Diphyes* is seen darting hither and thither amongst the brilliant blues of its brethren with its trailing fringes of bright orange polypites; and on the lonely western shores, as at Monach, countless myriads of the little *Velella* are tossed in autumn on the sand.

Mr Darwin *, referring to the colours of certain Invertebrate animals, thinks that it is doubtful if such serve as a protection; but he goes on to observe that the perfect transparency of the Medusæ, "many floating mollusca, crustacea, and even small oceanic fishes partake of this same glass-like structure," and that "we can hardly doubt that they thus escape the notice of pelagic birds and other enemies." It seems to me somewhat difficult to say what will escape the eye of a pelagic bird, such as gull, guillemot, or hawk-like tern. Their keen eyes distinguish very indistinct objects—for instance, the nucleus of *Salpa runcinata*, and the minute and almost transparent bodies of the young fishes that flit amongst the splendid masses of swimming jellies (Molluscan and Cœlenterate) which sometimes throng our western shores. The mere tremor of the water is almost sufficient to attract such acute and skilful marauders. Moreover, the statement of the great naturalist is incomplete without the appendix that many of the Medusæ and Hydromedusæ are brilliantly coloured and, in addition, phosphorescent, the latter property likewise characterizing the translucent *Pyrosoma*, and that my distinguished friend Prof. Wyville Thomson regards the luminosity of marine animals as a provision of nature for attracting their enemies in the abysses of the ocean, or for throwing a flood of light on their own prey. I have already † shown my reasons for believing that the theory of the latter author is open to doubt, and shall make a few further remarks on the subject under the Annelida. If the notion had been promulgated that the sexes in the abysses of the ocean used their light to attract each other, and thus had a better chance of continuing the race, perhaps more might have been said in its favour.

* Descent of Man, &c.

† Ann. & Mag. Nat. Hist. ser. 4, vol. ix. 1872, p. 2.

Genus AURELIA, Pér. & Les.

Aurelia aurita, O. Fabr.

Abundant in autumn and often so late as November.

Genus CYANEA, Pér. & Les.

Cyanea capillata, Eschsch.

Common in autumn.

Order LUCERNARIIDÆ

(*Calycozoa*, R. Leuck.).

Genus LUCERNARIA, O. F. Muller.

Lucernaria auricula, O. Fabr.

Frequent on Fuci near the commencement of the East Rocks, and occasionally at the West Rocks. It is as common as in the south.

Class CTENOPHORÆ.

Two representatives only are found at St. Andrews, viz. a species of Beroid and a *Pleurobrachia*. The former occurs in vast swarms in July, indeed almost as plentifully as in the Zetlandic seas, and is easily procured by the hand-net from the rocks or at sea. The latter is equally abundant from August to the end of autumn, and even in winter, occasionally filling the towing-net or the dredge in the bay, and thrown ashore after storms on the West Sands. Few objects are more engaging than one of these spherical jellies in a clear glass vessel of sufficient size to exhibit the matchless mechanism of of its complex tentacles and the splendid iridescence of its locomotive rows.

Order SACCATÆ, Agassiz.

Genus PLEUROBRACHIA, Flem.

Pleurobrachia pileus, Eschsch.

Abundant. It eagerly devours *Carcinus mænas* in the zoëa-stage.

Order BEROIDÆ, Ggbr.

Genus IDYIA, Fréminville.

Idyia cucumis, O. Fabr.

Occasionally in large numbers in July and August.

Class ACTINOZOA.

Though the total number of species of this class at St. Andrews is small, many occur in great abundance, and especially such cosmopolitan forms as *Actinia mesembryanthemum*, *Tealia crassicornis*, and *Actinoloba dianthus*. The frequent occurrence of *Sagartia troglodytes*, again, at St. Andrews, distinguishes it from the shores of the extreme south, as at Guernsey. We have not, moreover, the fine *Anthea cereus* of the west and south, which, for instance, in the quiet creeks of the Outer Hebrides studs the stems and blades of the tangles at the border of the littoral zone, the beautiful greenish purple tentacles gently waving with every swell of the tide; neither is the gaudily tinted *Sagartia parasitica*, so characteristic of some of our southern shores, to be found between tide-marks, nor *Adamsia palliata* in deep water. *Corynactis*, the stony corals, *Zoanthus*, and the northern free-swimming *Arachnactis albida* are entirely absent. The places of these are filled by swarms of the common forms above mentioned, and by some of the rarer types, e. g. *Edwardsia*, *Cerianthus*, and *Peachia*, which seem to be characteristic of sandy beaches. A remarkable example * of the latter turned inside out occurs in my collection. It was mistaken for a curious polyp with beautifully arranged longitudinal and transverse muscular bundles, and was found inserted in a tunnel in the sand in this condition in Cobo Bay, Guernsey. It is simply a large *Peachia* everted.

Amongst the Alcyonarians the phosphorescent *Pennatula* occurs in great beauty, and replaces the *Pavonaria* of the west, while with *Virgularia* it also affords a diagnostic mark from the south. The fine Gorgoniidæ of the latter region, again, have no representatives at St. Andrews.

Order I. ZOANTHARIA.

Suborder **ACTINARIA.**

Fam. 2. **Sagartiadæ**, Gosse.

Genus 1. ACTINOLOBA, Blainville.

Actinoloba dianthus, Ellis; Gosse, Brit. Anem. p. 12, pl. 1. fig. 1.

Common in the débris of the fishing-boats, and thrown ashore after storms attached to sticks and shells. Young spe-

* I am indebted to Dr. Cooper, of St. Peter le Port, for the specimen.

cimens occasionally appear on stones at extreme low water, and when very hungry greedily swallow green seaweeds. Some expand the disk like a *Doris* or *Lamellaria*, and float on the surface of the water.

Genus 2. Sagartia.

Sagartia troglodytes, Johnston; Gosse, Brit. Anem. p. 88, pl. 1. fig. 3, pl. 2. fig. 5, &c.

Everywhere abundant under stones, and attached to rocks near low-water mark. In regard to the physiology of the digestive sac, Mr. Gosse * states that the walls of this chamber are only separated for the reception of food; but in this species the mouth often expands, and the digestive cavity dilates, so as to be readily viewed as an open and empty sac. The ciliary currents course over the lip and into the stomach; so that minute particles of nutriment might be available, though by no means necessary.

Fam. 4. **Actiniadæ.**

Genus 1. Actinia, L.

Actinia mesembryanthemum, Ellis & Sol.; Gosse, Brit. Anem. p. 175, pl. 6. figs. 1–7.

Very common on stones and rocky ledges between tide-marks.

Fam. 9. **Bunodidæ.**

Genus 3. Tealia, Gosse.

Tealia crassicornis, O. F. Müller; Gosse, Brit. Anem. p. 209, pl. 4. fig. 1.

The variety *coriacea* (*Actinia coriacea*, Cuvier) is extremely abundant along the West Rocks at low water, while the other comes in great profusion and of large size from the deep water of the bay. A bifid specimen occurred at the Castle rocks. This species is also found in the stomach of the cod.

Genus 5. Stomphia, Gosse.

Stomphia Churchiæ, Gosse, Brit. Anem. p. 222, pl. 8. fig. 5.

Occasionally from deep water.

* Brit. Anem., Introd. p. xvi.

Fam. 6. **Ilyanthidæ.**

Genus 2. PEACHIA, Gosse.

Peachia hastata, Gosse, Brit. Anem. p. 235, pl. 8. fig. 3.

Thrown ashore on the West Sands after storms in great numbers, and was thus first found in Britain by Dr. John Reid, of St. Andrews, who published a description of his single example in 1848 (Physiological, Anat., and Pathol. Observations, p. 656, pl. 5. f. 21 & 22): his title (*A. cylindrica*) has therefore a prior claim to that of Mr. Gosse. It occurs also in the stomach of the cod.

Genus 4. EDWARDSIA, De Quatrefages.

Edwardsia callimorpha, Gosse, Brit. Anem. p. 255, pl. 7. fig. 7.

A variety was found on the West Sands after a storm in March, with brown instead of the usual whitish specks. It is an elongated form inhabiting sand.

Edwardsia Allmanni, M'I., Proc. Roy. Soc. Ed. 1864–5.

From a shallow pool on the West Sands after a storm in October. It inhabits a distinct case, and can retract its tentacles and cover them by the external border of the disk. The latter is marked by eight alcyonarian divisions or radii, and has always a ragged border of the investing sheath. The disk has a pale brownish colour.

The tentacles are simple, rather blunt, pale and translucent, with a white streak in the centre; the rim of the mouth is occasionally protruded as a conical process.

This form exhibited none of the "remarkably vigorous and spasmodic contractility" ascribed by Mr. Gosse to the family; for it was comparatively inert.

Edwardsia Goodsiri, M'I., Proc. Roy. Soc. Ed. 1864–5.

Found at the same time and place with the former. Tentacles 15, translucent, longer than the diameter of the oral disk, and not much tapered. A whitish ring occurs at the tip of each, and from the base a white spear-head with a transparent centre reaches more than halfway up. Oral disk streaked with white and brown. It is somewhat allied to *E. Beautempsii*, De Quatref.*, but is distinguished by the marks on the tentacles, which in the latter only have the tip "d'un beau jaune rougeâtre." The posterior end of the ex-

* Ann. des Sc. Nat. 2e sér., Zool. xviii. 1842, p. 69, pl. 1. fig. 1.

ample was often fixed to the glass by its ectoderm, which apparently had very minute or granular suckers.

Swarms of an *Edwardsia* occur in the stomach of the flounder.

Genus 6. CERIANTHUS, Delle Chiaje.

Cerianthus Lloydii, Gosse, Brit. Anem. p. 268, pl. 7. fig. 8, and woodcut, p. 269.

Procured at low water from the margin of the East Rocks, and occasionally thrown on the West Sands after storms. A splendid specimen from the latter (measuring 7½ inches long and as thick as a finger) in February discharged a vast number of ova after a week's confinement. The majority of these bodies were rather coarsely granular, ovoid in form; and some had minute papillæ at one end. No cilia were present, so that in all probability they were dead. Both examples had the first series of tentacles of the usual brown colour, with about four faintly marked whitish specks on the inner surface. The second series were uniformly brown.

Order II. ALCYONARIA.

Fam. **Pennatulidæ.**

Genus PENNATULA, L.

Pennatula phosphorea, L.; Johnst. Brit. Zooph. p. 157, fig. 35.

Abundant on muddy ground in deep water, and often brought up on the lines of the fishermen.

Genus VIRGULARIA, Lamck.

Virgularia mirabilis, L.; Johnst. Brit. Zooph. p. 161, pl. 30.

Occasionally in the stomach of the cod.

Fam. **Alcyoniadæ.**

Genus ALCYONIUM, L.

Alcyonium digitatum, L.; Johnst. Brit. Zooph. p. 174, pl. 34.

Abundant in deep water as well as in small patches on rocks and stones between tide-marks. Often thrown in large quantities on the West Sands after storms, attached to various submarine structures.

[To be continued.]

XXXI.—*On a true Carboniferous Nummulite.*

By Henry B. Brady, F.L.S., F.G.S.

[Plate XII.]

There are few time-marks in the geological record that have been regarded as better established or more definite than the first appearance of the Nummulite at or near the commencement of the Tertiary epoch; and any indications of an earlier history which would throw back the origin of this well-known genus to a Mesozoic or Palæozoic age can hardly be without interest to the student of those genealogical problems, the bases of which are found in the revelations of palæontology.

Dr. Carpenter, in his 'Introduction to the Study of the Foraminifera' (p. 276), says, "there is no fact in palæontology more striking than the sudden and enormous development of the Nummulitic type in the early part of the Tertiary period and its almost equally sudden diminution, bordering on complete extinction. The precise position of the immense beds of 'Nummulitic limestone,' the vast geographical extent of which has been already sketched, has been a subject of much discussion; but the researches of M. d'Archiac, Sir R. Murchison, Sir Charles Lyell, and others leave no further doubt that these beds belong to the earlier part of the Tertiary period, and that they correspond in position with the 'Calcaire Grossier' of the Paris basin, and with the 'Bracklesham' and 'Bagshot' beds of the London and Hampshire basins, in which deposits alone are Nummulites found in the British Islands. Although Nummulites have been described as existing at periods anterior to this, it seems probable that such descriptions have been founded on the occurrence of other helicoid Foraminifera bearing an incomplete resemblance to them."

The late Professor von Reuss, in his 'Entwurf einer systematischen Zusammenstellung der Foraminiferen'*, is scarcely less emphatic. He gives the distribution of the genus *Nummulites* as follows:—" Fossil (Tertiary, especially Eocene). *N. anti-*

* Sitzungsb. k. k. Akad. Wissen. Wien (1861), vol. xliv. p. 391.

It is not the object of the present paper to demonstrate the continuance of the genus through the later Tertiary to recent times; but, lest I should be supposed to agree with the latter part of this quotation, I may just state that, as far back as 1803, Fichtel and Moll figured two recent Nummulites from the Red Sea, under the names of *Nautilus radiatus* and *N. venosus* (Test. Micr. p. 59, pl. 8); and Messrs. Parker and Jones, in their essay on Fichtel and Moll's contributions to the Nomenclature of the Foraminifera, published a year or more before the above passage from Von Reuss, not only set this fact in a clear light, but instanced specimens in their collection of true recent *Nummulinæ* from Davis's Straits and from the Australian coral-reefs. I can only add that my own cabinet presents confirmatory evidence in abundance.

quior, Rouillier, from the Carboniferous limestone of Miatschkovo (*Orobias antiquior*, d'Eichwald), would form a remarkable exception if its complete agreement with *Nummulites* should be confirmed. I have not hitherto discerned any important distinction. The often-quoted living forms belong in part to *Amphistegina*, in part to *Operculina*."

Professor Seguenza, in a table of the geological range of the various genera of fossil Foraminifera* published almost simultaneously with the two works already quoted, gives with even greater decision the Eocene as the age of the appearance, the Miocene as that of the extinction of the true Nummulite.

It would be easy to add quotations of exactly similar import from the works of other palæontologists; but it is scarcely worth while to cite individual authorities for what, by its general acceptance, had come to be looked upon almost in the light of a geological dogma.

Gümbel's Researches.—Doubts as to the entire accuracy of this view have been raised from time to time, but they have not, until quite recently, been based on evidence sufficiently circumstantial to obtain much credence. Two years ago, however, Dr. C. W. Gümbel of Munich, in the preface to his memoir on certain "Jurassic precursors of the genera *Nummulites* and *Orbitulites*"†, reviewed the whole question of the existence of prætertiary Nummulites as it then appeared to stand. In his analysis the various published notices of Nummulites supposed to be of earlier geological age than the beginning of the Tertiary epoch are recounted, the circumstances on which they are founded criticised, and in some instances the results of a reexamination of the original specimens detailed. I propose to summarize the conclusions arrived at by Dr. Gümbel on this head, rather than venture upon an independent commentary, for which I should have but insufficient data.

Turning first to the Russian Carboniferous specimens already alluded to, Dr. Gümbel accepts Prof. Reuss's estimate of Rouillier's *Nummulina antiquior*‡—that is, that it may be a Nummulite, but that there is no sufficient evidence to prove the fact.

D'Eichwald's adoption of Rouillier's species, and his de-

* Foram. Monotal. di Messina, parte seconda (1862), p. 25.

† "Ueber zwei jurassische Vorlaufer des Foraminiferen-Geschlechtes Nummulina und Orbitulites," von Herrn Oberbergrath Dr. C. W. Gumbel. Neues Jahrbuch für Min., Jahrg. 1872, p. 241, pls. 7 & 8.

‡ Rouillier and Vosinsky, "Études progressive sur la Géologie de Moscou," Quatrième Étude. Bulletin Soc. Imp. des Naturalistes de Moscou, 1849, vol. xxii. p. 337.

scription of an allied symmetrical form*, the two being placed together as representatives of a new genus "*Orobias*" (*O. antiquior* and *O. æqualis*), is dismissed in the same way as affording no evidence of value, owing to the absence of any details of microscopical structure. Indeed D'Eichwald's separation of these two forms from the genus *Nummulina* is grounded on the non-tubulation of the shell and the lack of any indication of a canal-system in the specimens he had examined.

Buvignier† described and figured an Upper Jurassic Nummulite (*N. Humbertina*) from the Astarte-marl containing *Exogyra virgula*; but here, again, Dr. Gümbel regards the representation as insufficient to set its Nummuline affinity beyond dispute, though lending probability to the assumption.

More recently Fraas‡ obtained from the Cretaceous formation of Palestine certain fossils which he assigned to the genus *Nummulina*, describing them under three specific heads. With regard to the first of them, *N. variolaria*, var. *prima*, Dr. Gümbel supposes that the traveller has mistaken the age of the bed from which it was derived, but does not give any very clear ground for this conclusion. The *N. cretacea*, Fraas, after careful examination of the specimens, is assigned to the genus *Alveolina*; and, lastly, *N. arbiensis*, Conrad, though certainly a *Nummulina*, differs so little from *N. biarritzensis* and *N. variolaria* that it is set down as probably of Tertiary age.

Nummulina jurassica.—The author then proceeds to demonstrate the existence of the Nummulite in strata of the Jurassic period, and describes, under the name *N. jurassica*, certain minute fossils collected by the Geological Surveyors in Franconia. The precise horizon at which the specimens were found was a sponge-bed of the *Ammonites-tenuilobatus* zone § and a portion of the *A.-dentatus* zone; the locality, Schaflohe near Amberg. The specimens are stated to be

* Lethæa Rossica, par Edouard d'Eichwald (1855–1861), vol. i. p. 352, pl. 22. fig. 16.

† Stat. Géologie d. Dép. de la Meuse, 1852, p. 338; Atlas, p. 47, pl. 30. figs. 32–35.

‡ Geol. Beobacht. am Nil, auf der Sinai-Halbinsel u. in Syrien, 1867, S. 82–84, Taf. 1. fig. 8.

§ The "zone of *Ammonites tenuilobatus*" is one of Oppel's original divisions of the Jurassic strata, and is well marked in the south of the Grand-duchy of Baden. My friend G. A. Lebour, F.R.G.S., of the Geological Survey, sends me the following note, extracted from Dr. Waagen's 'Essai d'une Classification générale du Jura supérieur' (Munich, 1865):—"The zone of *Amm. tenuilobatus* and *Rhynchonella inconstans* is equivalent to the 'Lower Kimmeridge Clay' of England, the 'Corallien' of La Rochelle, the 'Astartien' of Switzerland, and the 'Scyphia Limestone' of Swabia and Franconia."

regular, lenticular, convex bodies 5 to 7 millimetres ($\frac{1}{5}$ to $\frac{1}{4}$ inch) in diameter and 1 to $1\frac{1}{4}$ millim. ($\frac{1}{25}$ to $\frac{1}{20}$ inch) in thickness, margin obtusely rounded rather than sharp, surface polished and without visible perforations; some specimens not quite flat, but twisted. A section parallel to the surface shows six or seven rather broad convolutions, each consisting of numerous segments, the primordial chamber being large, and the spiral widest near the centre. The tubulation of the shell is most distinct at its thickest part.

Another Nummuline fossil of Upper Jurassic age, from Mösskirch in Baden, is partially described in the same paper. This is stated to be similar in size to the foregoing, but distinguished from it by its numerous convolutions of *equal* size and its much larger primordial chamber. The specimens, which are in the Baden Geological Collection, appear to be too imperfect to admit of more accurate description.

Summary.—Accepting Dr. Gümbel's facts and, in the main, his analysis of the labours of previous authors, the scattered record of evidence as to the appearance of the Nummulite at periods anterior to the commencement of the Tertiary epoch may be summed up, in a few words, as follows:—

So far as relates to the Cretaceous system, some of the reported specimens are not Nummulites at all, and there is reason to doubt the geological origin of those which are*.

With respect to the Jurassic epoch, Buvignier probably, and Dr. Gümbel certainly, have obtained veritable members of the genus from undoubted Oolitic beds.

Lastly, although the researches of Rouillier and D'Eichwald on the fossils of the white limestones of Russia indicate a a possibility of the existence of the Nummulite in rocks of Carboniferous age, their figures and descriptions are such as no subsequent author has been able to accept as definite or entirely reliable evidence on the subject.

NUMMULINA PRISTINA, nov. sp.

Introductory.—At the British Association Meeting in

* Prof. Zeuschner (Verhandl. Russ.-kaiserl. min. Gesellschaft, St. Petersburg, Jahrg. 1847, p. 105) mentions the occurrence of Nummulites in large numbers in a dolomite of Neocomian age immediately overlying Liassic beds in the Carpathian Mountains. The paper is mainly geological, and the fossils are not minutely described; but the Nummuline character of the organisms in question is apparently sanctioned and approved by Von Keyserling in a short paper at p. 17 of the same volume. Reference to the notices of Lower Cretaceous Nummulites would be incomplete without some allusion to Zeuschner's memoir, although the evidence it affords may not be deemed conclusive; and it may have been omitted by Dr. Gümbel on this account.

September last I described a minute fossil, *Archædiscus Karreri*, the chief interest of which lay in two facts:—first, that whilst strikingly Nummuline in its essential features, it presented a wide divergence in some not unimportant points of structure from the typical Nummulite; and, secondly, that a fossil with such generic affinities occurred low down in the Carboniferous series at localities far apart. The description of *Archædiscus* had scarcely appeared * when I received from my friend M. Ernest Vanden Broeck, of Brussels, a couple of packets of calcareous material, which had been forwarded with the idea that it might be of service to me in investigating the Foraminifera of the Carboniferous period.

The total number of Foraminifera which accrued from a patient search through the contents of the two packets was exceedingly small. Not more, perhaps, than three species were represented. One of them is a familiar Carboniferous form; and another, of which only a single specimen was found, may turn out to be new. Neither of these need be noticed at present, as my object is with the third, which even cursory examination showed to be a true and most characteristic little Nummulite. Happily in the present instance no doubt need exist as to geological origin; for both locality and horizon are very accurately stated by M. Vanden Broeck; and though I hope at a future time, when I may have a larger supply of specimens to work upon, to be able to elucidate further some minor details of structure, the material at hand has been sufficient to serve for the demonstration of all essential characters.

Zoological Characters and Structure.—Externally these little fossils are convex disks; the larger specimens are about $\frac{1}{30}$ inch in diameter and $\frac{1}{70}$ inch thick; the periphery is usually blunt and rounded rather than acute. They are bilaterally symmetrical or nearly so, white and smooth as to surface, the uniformity being broken only by radial lines more transparent in texture than the rest of the shell. A section on the median plane reveals a spiral of three or four convolutions, the whorls being nearly equal in width or only increasing slightly towards the periphery, a primordial chamber relatively rather large, the ordinary chambers few in number for a Nummulite, and bounded by curved septa.

The characters thus broadly stated may now be examined in detail.

With respect to the exterior but little more need be said. The relation between the diameter and thickness is apparently tolerably constant—that is, about as 2½ to 1; larger examples, however, exhibit some tendency to spread out and grow thinner

* *Vide* Ann. & Mag. Nat. Hist. October 1873, p. 286.

at the periphery. When the surface of the test is not worn, the radiation is either very indistinct or appears in the form of curved lines of somewhat darker colour, but without sensible limbation; but in weathered specimens not only are the lines more or less elevated, but the centre from which they proceed is thickened and the test becomes to some extent umbonate also.

An accidentally split specimen (Pl. XII. fig. 4) will serve the purpose of a horizontal section. It consists of three convolutions, the outermost having sixteen chambers, and the second twelve or thirteen. Another, somewhat larger individual has precisely similar septation; so that, without assigning any great importance to it, the drawing may be assumed to represent a specimen with about the normal number of chambers for the adult condition.

The primordial chamber has been measured in three examples, and the diameter found to be ·004, ·003, and ·0027 of an inch, being respectively from $\frac{1}{7}$ to $\frac{1}{10}$ of the entire diameter of the test.

The minute tubulation of the shell is perfectly preserved, and may be easily seen in the transverse section under a magnifying-power of 100 diameters, as in Pl. XII. fig. 3.

The canal-system of the septa and marginal cord may be traced here and there, though only imperfectly. The transverse section (fig. 3) gives distinct evidence of the existence of the marginal cord; but the details of the structure are obliterated; and in the more highly magnified drawing (fig. 5) indications are not wanting of canals traversing the septa as well as the supplementary skeleton.

Such is a detailed account, as far as can be furnished from the materials available, of the finer specimens of this Carboniferous Nummulite; and in the absence of larger individuals or of fragments indicating their existence, they may fairly be supposed to be adults and fully developed examples of the species. But, in addition to these, a number of smaller individuals have been found apparently belonging to the same form, though neither so uniform in external appearance nor so unmistakably nummuline in character. One or two are somewhat explanate in their mode of growth, and if mature may pertain to an "Assiline" variety. Others, smaller still, not much more than a hundredth of an inch in diameter, are unsymmetrical, the convexity of the two faces being unequal and irregular. They probably represent either one of the early stages of the organism or perhaps an arrested condition of growth. Their precise relation to the fully developed form must be left for future determination, in the lack of sufficient specimens to work the question fully out.

Affinities.—The *Nummulina antiquior* of Rouillier and Vosinsky, judging from the figures accompanying their memoir, is essentially unsymmetrical. Not only are the two faces very unequal in their convexity, but there seems also a tendency to irregularity in the contour of the periphery. The *Orobias æqualis* of D'Eichwald much more nearly resembles the specimens before us in external characters. Its separation by the author from the genus *Nummulina*, on the ground of the minute structure of the shell (resting, as it apparently does, on negative data), need not be insisted upon. The absence of evidence of tubulation or canals may be dependent upon the process of mineralization; and their detection in fossils so minute, taken from a compact calcareous rock of such an age, must always be attended with difficulty. Nevertheless some doubt must rest upon this species until further specimens from the same locality, or at least from a similar horizon, have been minutely examined; and as it differs materially in size* and septation from the organism just described, it appears undesirable to associate them under the same specific name. I propose therefore for the Belgian specimens the name *Nummulina pristina*.

Referring to D'Archiac and Haime's monograph†, the figures most closely resembling the new *N. pristina* are those of *N. variolaria*, Sowerby, which represent a Nummulite of somewhat larger dimensions but remarkably similar in general external characters and septation. Thus the nearest allies, zoologically speaking, of the Carboniferous form are the small thick members of the "radiate" group regarded by Messrs. Parker and Jones as the western modifications of *N. planulata*‡. *N. variolaria* especially is a poor and variable form whose descent may be easily traced.

It is not a little singular that in the Carboniferous precursor of the Nummulitic group we should have an organism so exactly corresponding in minutest features with its most modern representatives. This cannot be a mere coincidence. Is it not rather a curious exemplification of persistence of essential characters through innumerable ages, whilst modifications of the original, forming collateral "species," have, under favourable circumstances, exhibited an extraordinary development in size and complexity of structure and a corresponding increase in geological importance? Then, as external conditions have become less favourable, little by little,

* The diameter, as given by D'Eichwald, is five times as great as the largest of the Belgian specimens.

† Descr. des Anim. foss. du groupe Nummulitique de l'Inde, p. 146, pl. ix. fig. 13, *a–g*.

‡ See Messrs. Parker and Jones on the nomenclature of the genus, Ann. & Mag. Nat. Hist. 3 ser. vol. viii. p. 231.

the type has reverted to its primitive state, gradually dwindling in size, and losing by degrees those minor characters which were the easily recognized evidence of higher organization, and in its later history suggesting the lingering stages which precede complete extinction.

It has been already stated that one of the Nummulites described by Fraas from the Cretaceous beds of Palestine is named *N. variolaria*, var. *prima*, and that Dr. Gümbel's objection to its being accepted as a Cretaceous representative of the genus appears to be grounded solely on its supposed zoological affinity. The discovery of a form so similar, in rocks of a still earlier period, appears to render such an objection untenable unless otherwise supported.

Locality and Geological Position.—The locality whence the material containing the specimens above described was obtained is a Carboniferous-Limestone quarry near Namur—"*la Carrière du Fond d'Arquet*"—the exact geological relations of which will be best understood by a brief abstract of particulars, furnished to me by M. Vanden Broeck.

The Carboniferous Limestone of Belgium is divided by M. Dupont into six sets of beds, which have been named from the localities in which they are respectively best developed. They are as follows, beginning at the lowest:—*des Ecaussines*, *de Dinant*, *d'Anseremme*, *de Vaulsor*, *de Namur*, and *de Visé*. The section at the Carrière du Fond d'Arquet belongs to the top but one of these divisions, which is described as a black dolomitic limestone with large *Euomphali*—black and compact at the base, and dolomitic in the upper portion, the characteristic fossils being *Euomphalus æqualis* and *E. acutus*. The material collected was from three distinct bands of marly calcareous shale near the base of the section. Two out of the three contained examples of the Nummulite, though the number of specimens was exceedingly small in proportion to the quantity of material, and, owing to the nature of the matrix, almost all of them were more or less broken.

It may be well to mention that a single Nummulite of the same species has been found in a packet of greyish limestone débris from Flémalle near Liége, which, geologically, pertains to the uppermost of the divisions above quoted—that of "Visé;" but until further specimens have been obtained from the same horizon, this second locality must be regarded as requiring confirmation.

It only remains for me to express my grateful acknowledgments to M. Ernest Vanden Broeck of Brussels, to whom I am indebted for the material in which this interesting little Nummulite has been found. To the pains he has taken to verify every particular as to the exact position of the beds in

which it occurs, sparing no labour to ensure complete accuracy, the reliability of the geological portion of the present paper is entirely due.

To the kindly criticism of my friend and colleague Professor T. Rupert Jones, F.R.S., during the course of my work, I owe a good deal; and it is no small thing that in the results, as detailed in the foregoing pages, I have the entire concurrence of one who has contributed so much to place the classification and nomenclature of the genus *Nummulina* on an intelligible basis.

EXPLANATION OF PLATE XII.

Fig. 1 represents the lateral aspect, *fig.* 2 the periphero-lateral aspect of *Nummulina pristina*, magnified 50 diameters. Except a very trifling portion of the last convolution (which is broken away), this specimen is quite perfect.

Fig. 3 is a very accurate drawing of a transverse section, almost entire, magnified 100 diameters. It shows the somewhat large primordial chamber, the investing character of the alar lobes of the chambers of the spire, and the lamination of the test arising therefrom. The general tubulation of the shell is well seen; and at the lower end of the drawing indications of the marginal cord may be distinctly traced, though wanting in definition.

Fig. 4 is from a specimen accidentally split at the median plane, magnified 50 diameters, one of several, more or less perfect, found in this condition. The tendency to split horizontally at the median line is of itself a Nummuline peculiarity of some significance.

Fig. 5 shows a small portion of a horizontal section, much more highly magnified (200 diameters), the object being to demonstrate the existence of a canal-system in the septa and peripheral region. More difficulty has been experienced in obtaining good horizontal sections than transverse; this, however, has been sufficient to yield to Mr. Hollick (who has drawn direct from the object) very characteristic details of structure at one point in the peripheral convolution.

XXXII.—*Notice of some new Species of Fishes from Morocco.*

By Dr. ALBERT GÜNTHER, F.R.S., Foreign Member of the Senckenberg Society of Frankfort.

[Plates XIII. & XIV.]

A SMALL collection of marine and freshwater fishes, made by Dr. Rein and Dr. C. von Fritsch during their journey in Morocco, was placed by the former gentleman in my hands for examination. It contained four new species, which may be characterized as follows:—

Serranus atricauda.

D. $\frac{10}{15}$. A. $\frac{3}{8}$. L. lat. 115.

I am unable to identify a specimen from Mogador with any

of the species described as being allied to *Serranus cabrilla* or *Serranus scriba*, the scales being considerably smaller than in any of those species. There are eleven scales in a transverse series between the dorsal fin and the lateral line. The height of the body is two sevenths of the total length (without caudal), the length of the head one third. Snout scaleless, pointed, with the lower jaw slightly prominent, the maxillary extending beyond the vertical from the middle of the eye. The diameter of the eye is two ninths of the length of the head and two thirds of that of the snout. Interorbital space flat, much less than the diameter of the eye. The serrature round the angle of the præoperculum is much coarser than on the remainder of the bone. The fourth, fifth, and sixth dorsal spines are the longest. Ventral fin terminating at a great distance from the vent; caudal truncated. Reddish olive (in spirit), with several dark cross bands, most distinct in the middle of the side of the body; two of them are darker and broader than the rest, and occupy the middle of the body. An oblique dark streak from the eye to the angle of the præoperculum. The soft vertical fins with numerous very small bluish ocelli. Corners of the caudal fin deep black.

I find that the specimen from Mogador is identical with others in the British Museum from the Azores, Madeira, and the Canary Islands (Teneriffe) which I have hitherto confounded with *S. cabrilla*.

Barbus Reinii. Pl. XIII.

D. 11. A. 8. L. lat. 32. L. transv. 5/6.

The osseous dorsal ray is strong, smooth, its stiff portion being two thirds as long as the head. There are two and a half or three series of scales between the lateral line and the root of the ventral fin. The height of the body is a little more than the length of the head, which is one fourth of the total (without caudal). Snout moderately produced, obtusely conical. Mouth inferior; lips not thickened; barbels longer than the eye. The origin of the dorsal fin is distinctly in front of the root of the ventral, and nearly midway between the end of the snout and the root of the caudal. Caudal fin deeply forked. Coloration uniform.

This species inhabits the river Tensift. The largest of the three specimens examined is 8½ inches long.

Barbus Fritschii. Pl. XIV. fig. A.

D. 11. A. 9. L. lat. 32–33. L. transv. 5½/5.

The osseous dorsal ray is feeble, not much stronger than the

others, and not serrated. There are two and a half longitudinal series of scales between the lateral line and the root of the ventral. The height of the body is contained thrice and one fourth in the total length (without caudal), the length of the head four times. Snout short and obtuse, with the mouth inferior, broad, short, and crescent-shaped; the lower jaw with rather a sharp margin. Barbels four, short. The diameter of the eye equals the length of the snout, and is two sevenths of that of the head. Origin of the dorsal fin nearly midway between the end of the snout and the root of the caudal, opposite to the base of the ventral. Anterior anal rays very long, extending beyond the root of the caudal. A more or less distinct narrow greyish longitudinal band runs from the back part of the eye above the lateral line to the middle of the caudal fin, and separates the darker coloration of the back from the silvery of the belly.

This is a small species, apparently abundant in the streams near Morocco (Oued Ksib). The largest specimen is only 4½ inches long.

Barbus nasus. Pl. XIV. fig. B.

D. 11. A. 8. L. lat. 45. L. transv. 9/10.

Osseous dorsal ray strong, strongly serrated. There are five longitudinal series of scales between the lateral line and the ventral fin. The length of the head is rather more than the height of the body, and one fourth of the total (without caudal). Snout very long, much pointed, as long as the postorbital portion of the head; lips very thick, the lower with the fold interrupted in the middle; mouth inferior; barbels very fleshy and much longer than the eye, which is small. The base of the ventral fin is conspicuously in advance of the origin of the dorsal fin, which is nearly equidistant between the end of the snout and the root of the caudal. Anal fin not very narrow, none of the rays extending to the caudal. Caudal deeply forked. Coloration uniform.

The larger of the two specimens sent is 5½ inches long. They bear the number 39; and on referring to the corresponding number in the list of localities I find that the specimens are said to have been obtained, with other marine fish, on the sea-shore near Mogador; I cannot help thinking that some mistake has taken place, and that these specimens were obtained from fresh water, like the other species of this genus.

XXXIII.—*On the Geodephagous Coleoptera of New Zealand.* By H. W. Bates, F.L.S.

It has been stated that the insect-fauna of New Zealand is extremely poor, and that the Coleoptera at least show great affinity with those of north temperate regions. With regard to the former statement, although some weight ought to be attached to the unanimous complaint of collectors of the general scarcity of insects, it is premature to arrive at a definite conclusion so long as the islands have not been thoroughly worked. At present we know scarcely any thing of the productions of the central and western portions of the Northern Island, or of the mountainous districts of the Canterbury Province in the Southern. Although insular and, especially, oceanic faunas are known to be poor, it remains to be seen whether the large area, varied surface, and lofty mountain-ranges of New Zealand have not operated to check the process of extinction without repopulation which has impoverished other insular areas. At present the total number of species of Geodephagous Coleoptera known from the islands is 89; the British Isles have 311, and Japan 244.

The belief that the New-Zealand Coleopterous fauna is related to that of the north temperate zone is certainly ill-founded; but it was excusable so long as describers, without attempting to study the characters of the new species before them, referred them recklessly to familiar northern genera, such as (to cite cases from the present group) *Dromius*, *Cymindis*, *Calathus*, *Lebia*, *Harpalus*, &c., the species so referred having no near affinity whatever to those genera, but belonging to purely Australian or Antarctic forms. Our material, as far as it goes, shows a great specialization of the New-Zealand fauna. Thus, out of the total number of 37 New-Zealand genera of Geodephaga, no fewer than 14 are peculiar to the islands; of the remainder, 8 are Australian and 2 are Chilian: 7 genera only are common to New Zealand and the north temperate zone; and these are genera of universal distribution. There remain 6 genera, described as *Argutor*, *Feronia*, &c., which I have not yet seen, and therefore class as doubtful.

Many of the species described or enumerated in the following paper have been communicated by Messrs. Wakefield and Fereday, of Christchurch, and Mr. Lawson, of Auckland; and it is at the desire of these gentlemen and other local naturalists, who are labouring to gather together the scattered materials of the New-Zealand fauna, that I have undertaken this task.

Coleoptera Geodephaga.

Family **Cicindelidæ**.

Cicindela tuberculata, Fab. Syst. Entom. p. 225.

Northern and Southern Islands. Auckland; Christchurch.

Cicindela latecincta, White, Voy. Ereb. & Terr., Ins. p. 1, t. i. f. 1.

Southern Island. Canterbury.

This form is generally considered a variety of *C. tuberculata*. The differences, however, are considerable; for besides the width of the lateral white stripe, which reaches throughout the lateral rim of the elytra, it is a broader insect, with the elytral surface more uniform in colour and, particularly, the rows of punctures much less marked and with smaller green spots. It must rest with local entomologists to decide, by observing the forms *in situ*, whether they are distinct or not.

Cicindela Wakefieldi, n. sp.

C. tuberculatæ similis, at multo minor et angustior; fascia alba mediana elytrorum postice oblique prolongata. Long. 4 lin. ♂ ♀.

Very similar to *C. tuberculata* in sculpture, colours, and markings, but certainly distinct. It is always much smaller and narrower; and although the lateral white stripe of the elytra is very similar in form and direction, the median fascia is prolonged as a curved streak some distance down the disk of the elytron. There is also a structural difference in the apex of the elytra, which may better be expressed by a tabular formula:—

Cicindela tuberculata.	*Cicindela Wakefieldi.*
Elytrorum apicibus	Elytrorum apicibus
♂ conjunctim prolongatis, sutura longe spinosa,	♂ conjunctim late rotundatis, sutura breviter spinosa,
♀ conjunctim rotundatis, sutura acute spinosa.	♀ singulatim abrupte rotundatis (vel ad suturam fortiter conjunctim emarginatis), sutura breviter spinosa.

Very local, near Christchurch. Sent in some numbers by C. M. Wakefield, Esq., but first discovered by Mr. Fereday, of Christchurch.

Cicindela Douei, Chenu; Guér. Mag. de Zool. 1840, pl. xlv.

The figure represents an elongate species evidently of the *tuberculata* group, a little shorter than *C. tuberculata* (11 millims. = 5 lines). It is distinguished at once by the apical

white lunule of the elytra being represented by a subapical spot.

The locality "New Zealand" given to this species rests on the assurance of a dealer, who was told by the surgeon of a whaling-ship that it was taken there. I have seen no specimen of it.

Cicindela Parryi, White, Voy. Ereb. & Terr., Ins. p. 1, t. i. f. 2.

Port Nicholson; Christchurch.

Cicindela dunedensis, Castelnau, Trans. R. Soc. Victoria, pt. 1, vol. viii. p. 35.

Dunedin.

The author compares it to *C. Parryi*, from which it differs by being narrower. It is "light brown, the elytra covered with spots of a green copper-colour." In this respect it differs much from *C. Wakefieldi*.

Cicindela Feredayi, Bates, Entom. Monthly Mag. vol. iv. p. 53 (1867).

Mr. Wakefield has recently met with this species in numbers on the sandy bed of the Rakaia near Christchurch. It is distinct from all the members of the *tuberculata* group, in its finely granulated elytra without traces of green foveoles.

Family **Carabidæ.**

Section A. *Mesothoracic epimera reaching the middle coxæ.*

Subfamily *Migadopinæ.*

Amarotypus Edwardsii, Bates, Entom. Monthly Mag. vol. ix. p. 51 (1872).

I have only seen of this curious insect the specimens sent me by Mr. H. Edwards, who took it in New Zealand *.

Subfamily *Scaritinæ.*

Clivina rugithorax, Putzeys, Stett. Zeit. 1866, p. 37.

A large species (nearly 5 lines), closely allied to a common Australian species, *C. australasiæ*, Boh. I have not yet seen it.

* *Heterodactylus nebrioides*, Guér. (*Pristancylus castaneus*, Blanch.), from the Auckland Islands, is another member of this very interesting antarctic group of Carabidæ. *Pristancylus brevis*, Blanch., from the same locality, is doubtful.

Section B. *Mesothoracic epimera not reaching the middle coxæ.*

Subfamily *Broscinæ.*

Mecodema sculpturatum, Blanchard, Voy. au Pôle Sud, Zool. vol. iv. p. 34, t. ii. f. 14.

Mecodema Howittii, Casteln. Trans. R. Soc. Victoria, pt. ii. vol. viii. p. 159 (=*rectolineatum*, Putz. Stett. Zeit. 1868, p. 317).

Mecodema rectolineatum, Casteln. *l. c.* p. 160; Putz. Annali del Mus. Civ. di Genova, vol. iv. p. 4.

Mecodema impressum, Casteln. *l. c.* p. 161; Putz. *l. c.* p. 4.

Mecodema lucidum, Casteln. *l. c.* p. 160; Putz. *l. c.* p. 5.
"Dunedin."

Mecodema crenicolle, Casteln. *l. c.* p. 160; Putz. *l. c.* p. 6.
"Auckland."

Mecodema simplex, Casteln. *l. c.* p. 160; Putz. *l. c.* p. 7.
"Auckland."

Mecodema alternans, Casteln. *l. c.* p. 161.

Mecodema crenaticolle, Redtenbacher, Reise d. Novara, Coleopt. p. 11.

I have not yet seen any species of *Mecodema* from the neighbourhood of Christchurch.

Metaglymma tibiale.
Maoria tibialis, Casteln. *l. c.* p. 163.
"Molyneux River; in the mountains."

Metaglymma monilifer, Bates, Entom. Monthly Mag. vol. iv. p. 79 (1867).
Near Christchurch. Discovered by Mr. Fereday.

Metaglymma punctatum, Putz. *l. c.* p. 8.
Maoria punctata, Casteln. *l. c.* p. 164.
"Dunedin; in the mountains."

Metaglymma morio, Putz. *l. c.* p. 9.
Maoria morio, Casteln. *l. c.* p. 164.
Otago.

Metaglymma elongatum, Putz. *l. c.* p. 9.
Mecodema elongatum, Casteln. *l. c.* p. 162.

Metaglymma aberrans, Putz. Stett. Zeit. 1868, p. 320.

Metaglymma clivinoïdes.

Maoria clivinoides, Casteln. *l. c.* p. 164.

"Wellington."

Metaglymma dyschirioïdes.

Maoria dyschirioides, Casteln. *l. c.* p. 164.

"Crooked River."

Oregus æreus.

Promecoderus æreus, White, Voy. Ereb. & Terr., Ins. p. 5, t. 1 f. 8.
Oregus æreus, Putz. Stett. Zeit. 1868, p. 327.

Port Nicholson (*White*).

Oregus inæqualis.

Mecodema inæqualis, Casteln. *l. c.* p. 162.

"Dunedin."

Brullea antarctica, Casteln. *l. c.* p. 166.

"Auckland."

Obs. Percosoma carenoïdes (*Broscus*), White, Voy. Ereb. & Terr. p. 4 (Tasmania), and *Promecoderus Lottini*, Brullé, Hist. Nat. Ins. iv. p. 450 (Swan River), have been erroneously given as New-Zealand insects.

Subfamily Licininæ.

Rembus zeelandicus, Redtenb. Reise Novara, Coleop. p. 10, t. i. f. 5.

"Auckland."

A large species (9½ lines), of which I have seen no specimens from New Zealand. The description and figure agree pretty well with a Chinese species; and there may be an error in the locality.

Dicrochile subopaca, n. sp.

D. oblongo-ovata, subdepressa, nigra, palpis et tarsis rufo-piceis; elytris alutaceis, subopacis; capite parvo; thorace quadrato, postice modice angustato. Long. 4¼–5 lin.

Shorter in form than the common Australian *D. Goryi*, and the elytra more ovate; distinguished also by the alutaceous and subopaque surface of the elytra. The head is relatively small, as in *D. Goryi*. The thorax is quadrate, moderately narrowed behind, with explanated and reflexed margins; the hind angles obtuse and rounded at the tip, the middle of the

base broadly sinuated. The elytra are elliptical-ovate, obliquely and strongly sinuate near the tip, with the suture produced; the lateral margins are somewhat explanated and reflexed, the striæ sharply impressed, the interstices scarcely convex.

Apparently abundant near Christchurch.

Dicrochile aterrima, n. sp.

D. oblonga, nigra, nitida; capite majore; thorace breviore, transverso, quadrato, postice paulo angustato, angulis posticis obtusis, apice rotundatis, margine vix reflexo; elytris oblongis, nitidis, fortiter punctulato-striatis, interstitiis alternis magis elevatis. Long. 5 lin.

Same size as *D. subopaca*, but distinguished at once by its deeper black colour and shining surface, by its larger head (owing chiefly to the much more prominent eyes), and much shorter, more transverse thorax. The palpi and tarsi are also shining black. The elytra are much less sinuate truncate, and the sutural apex less produced; the striæ are punctulate, and the interstices more convex, especially the third, fifth, and seventh.

Taken by Mr. C. M. Wakefield in some numbers at Lake Coleridge, under stones in a dry lagoon.

Dicrochile ovicollis, Motschulsky, Bull. Mosc. 1864, iv. p. 316.

By its elytra "paulo opacis," this may possibly be our *D. subopaca*; but the description of the thorax cannot possibly be intended for that species ("capite fere duplo latiore, ovali"). There is not the faintest approach to the oval form in the thorax of *D. subopaca*.

Obs. Dicrochile Fabrei and *D. anchomenoïdes*, cited by authors as described by Guérin (Ann. Soc. Ent. Fr. 1846, Bull. p. 103), must be erased from the list of this genus, as the species are merely named in the place quoted, not described.

Subfamily *Anchomeninæ*.

Calathus zeelandicus, Redtenb. Reise Novara, Col. p. 17.

Auckland.

It is doubtful if this belongs really to the genus *Calathus*. *C. rubromarginatus*, Blanch., from the Auckland Islands, is decidedly not a *Calathus*, having, according to Chaudoir, four joints of the male anterior tarsi dilated and brush-like beneath.

Platynus deplanatus.

Anchomenus deplanatus, White, Voy. Erebus and Terror, p. 3 (1846).
A. atratus, Blanch. Voy. Pôle Sud, Zool. iv. p. 21, t. 1. f. 15 (1853).

Blanchard's description is so vague that it is difficult to determine to which of the New-Zealand species of the same size (12 to 14 millims.) it applies. Judging from the figure and the expressions "ater, obscurus" and "Elytres obscures, planes," I refer to it a slender, subopaque species existing in some of the London collections, and remarkable for the very sharp furrows and ridges of all the tarsi, and for the uneven slightly rugose thorax, which is subcordate in form, but with produced and rather acute hind angles. The head and eyes are very similar in form to those of *P. scrobiculatus* of Europe. White's description of *A. deplanatus* agrees pretty well with the same insect; and I have little hesitation in adopting the name, although I have not seen his type.

Platynus Colensonis.

Anchomenus Colensonis, White, *l. c.* p. 3.

The type in the British Museum is a slender insect, with very elongate thorax, sinuate-angustate behind, and with produced hind angles; the antennæ, palpi, and legs testaceous yellow.

The size is 5¾ lines; but I refer to the same species two specimens collected by Mr. Henry Edwards, 4¾ and 5 lines in length respectively.

Platynus Edwardsii, n. sp.

P. elongatus, modice convexus, niger nitidus, palpis, antennis (articulis 1.–3. exceptis) et tarsis rufo-piceis; capite ovato, pone oculos subconstricto, supra lævi; thorace angusto, quadrato-cordato, post medium fortiter sinuato, angulis posticis productis, acutis; elytris elongato-ovatis, apice fortiter sinuatis, convexis, profunde subpunctulato-striatis, interstitio tertio tripunctato. Long 5–5½ lin. ♂ ♀.

Allied to *P. Colensonis*, especially in the form of the thorax, with produced acute hind angles, but legs constantly pitchy black; palpi and antennæ dull pitchy red, with the greater part of the three basal joints of the latter black. The thorax, as in *P. deplanatus* and *P. Colensonis*, has a deep central groove, and on each side a curved, shallow, impressed line proceeding from the basal fovea and nearly reaching the anterior angles. The lateral explanated margin is narrow and reflexed. All the tarsi (except the dilated joints of the male) are sharply ridged and grooved, as in *P. deplanatus*.

Anchomenus elevatus, White, *l. c.* p. 3.

A large, shining black species (6½ lines), with large ovate thorax, much larger in proportion to the elytra than in any other described species. The hind angles of the thorax are very obtuse, almost rounded; and the lateral margins are widely explanated and strongly reflexed, of the same width from the anterior to the posterior angle. The elytra are ovate, rather rounded at the shoulders, and strongly sinuate near the apex. The tarsi are grooved only on the sides.

Auckland. Sent in some numbers by Mr. Lawson.

Anchomenus Feredayi, n. sp.

A. oblongus, subgracilis, nigro-æneus nitidus, thoracis margine laterali, elytrorum margine deflexo, tibiis tarsisque obscure piceo-rufis; thorace transversim quadrato, angulis posticis distinctis sed obtusis; elytris striatis, interstitiis planis, tertio tripunctato. Long. 3½ lin. ♂ ♀.

A small "*Agonum*," having much resemblance to the British *A. micans*, but distinguished, among other characters, by the shorter thorax, scarcely more narrowed behind than in front, with distinct hind angles and pitchy and explanated lateral margins; the anterior angles are rather rounded, not prominent as in *A. tristis*, Dej. The eyes are much more prominent than in *A. micans*, and the palpi shorter and more robust. The frontal foveolæ are deep and well defined. The elytra are very obliquely and rather strongly sinuate at the apex, with the suture strongly produced; the striæ are sharp and fine, equally impressed from base to apex, and finely punctulate or crenulated; the interstices quite plane, with three large punctures on the third; the deflexed margins and extreme edge of the lateral rims rufo-piceous. The antennæ are robust from the fourth joint, black, with rufous bases to the joints. The palpi and femora shining black; the trochanters reddish testaceous; the tibiæ and tarsi pitchy red. The tarsi are finely grooved on the sides only.

Christchurch. Sent first by Mr. Fereday, and afterwards by Mr. C. M. Wakefield.

Anchomenus Lawsoni, n. sp.

A. oblongus, gracilis, nigro-piceus æneo-tinctus, nitidus; partibus oris, antennis, pedibus (femoribus exceptis), thoracis elytrorumque marginibus lateralibus piceo-rufis; capite convexo; thorace paulo transverso, subquadrato, lateribus rotundatis, postice plus quam antice angustato, angulis posticis obtusis sed distinctis;

elytris fortiter striatis, interstitiis subconvexis, tertio tripunctato. Long 4 lin. ♂ ♀.

Longer and proportionally narrower than *A. Feredayi*. Thorax conspicuously longer, the posterior narrowing more gradual, and slightly incurved before the hind angle; striæ of the elytra deeper, and interstices more convex. The antennæ, parts of the mouth, and legs also differ in being wholly dull rufous, except the femora, which are blackish. The anterior angles of the thorax are not at all advanced and are rounded off.

Auckland. Collected by Mr. Lawson.

Anchomenus submetallicus.

Colpodes submetallicus, White, *l. c.* p. 2.

According to the type in the British Museum, this is a species closely allied to the common Australian *A. marginellus* (Erichson); it differs in being less shining, and in the much shorter thorax, the sides of which narrow much more abruptly to the front angles. It is common and generally distributed in New Zealand; and I have compared a long series with an equal number of the Australian species.

The species has none of the distinguishing characters of *Colpodes*; the fourth joint of the tarsi, however, is rather more distinctly triangular and emarginate than is usual in *Anchomenus*. It is closely allied to our *A. Feredayi*, but is much larger, more brassy, and with clearer yellow margins to the thorax and elytra, besides having yellow legs.

Tropopterus sulcicollis, n. sp.

T. ellipticus, niger, nitidus; antennis, palpis et pedibus piceo-rufis; capite spatio inter sulcos laterales haud carinato; thorace quadrato, vix transverso, medio rotundato, antice plus quam postice angustato, angulis posticis productis rectis, basi utrinque fovea sulciformi; elytris convexis, striato-punctatis. Long. 3¼ lin. ♀.

Resembles the genus *Oöpterus*, but distinguished by the pubescence of the antennæ not beginning before the fourth joint, and by the labial palpi having their terminal joint obtuse-ovate, instead of acuminate. Agrees in all essential points with the Chilian genus *Tropopterus*; allied to *Colpodes*, in which the forehead has on each side two grooves with a carinate interval between them. The eighth and ninth striæ of the elytra are sunk in a broad groove near the apex; and the seventh at that part is bordered by a sharp carina. The sixth and seventh striæ are nearly obsolete.

One example, female, sent by Mr. Fereday from Christchurch.

Tropopterus seriatoporus, n. sp.

T. ovatus, elytris gibbosis; castaneo-rufus, nitidus; thorace basi grosse punctato; elytris grosse seriatim punctatis. Long. 2½ lin. ♀.

The labial palpi are obtuse; the maxillaries taper to a point almost as in *Oöpterus*. The posterior narrowing of the thorax is strongly sinuated and the hind angles produced; the whole base is very coarsely punctured; the dorsal line and long basal foveæ are deeply impressed. The sutural rows of punctures are impressed in striæ, the rest are superficial; the form of the lateral striæ is as in *T. sulcicollis*.

Mr. H. Edwards; one example.

Cyclothorax insularis.

Olisthopus insularis, Motschulsky, Bull. Mosc. 1864, iv. p. 325.
Drimostoma striatopunctata, Casteln. *l. c.* p. 199 (?).

Differs scarcely from the common Australian *Anchomenus ambiguus*, Erichs. (*Cyclothorax* id., W. M'Leay), the only difference observable being its more æneous colouring.

Auckland and Canterbury.

Drimostoma antarctica, Casteln. *l. c.* p. 199.

M. de Chaudoir suspects this to be an *Abacetus*. I have seen at present no species of either genus from New Zealand.

Subfamily PTEROSTICHINÆ.

Prosopogmus impressifrons, Chaudoir, Bull. Mosc. 1865, p. 28 (separata).

A large species, about 8 lines long, which I have not seen. It is similar in form to *Pt.* (*Trichosternus*) *australasiæ*, but much flatter and of a brilliant brassy coppery hue, with flattened tarsi, having their upper surface finely reticulated.

Trichosternus antarcticus, Chaudoir, Bull. Mosc. 1865, iii. p. 73.

Megadromus viridilimbatus, Motsch. Bull. Mosc. 1865, iv. p. 251.

This fine insect was sent home in some numbers, from Christchurch, by Mr. Fereday. The colour is not always cupreous, but some specimens are black, with the green margins occasionally scarcely perceptible. It may always be distinguished from the obscure-coloured *T. rectangulus* by its larger and broader shape, more protuberant cheeks behind the eyes, and by the thorax being more dilated in front.

Trichosternus rectangulus, Chaud. Bull. Mosc. 1865, iii. p. 74.

Christchurch. Sent both by Mr. Fereday and Mr. Wakefield.

Trichosternus capito, White, *l. c.* p. 4.

Closely allied to *T. rectangulus*; but I have seen no specimens from Christchurch exactly resembling White's types in the British Museum.

Trichosternus Guerinii, Chaud. Bull. Mosc. 1865, iii. p. 75.

Platysma australasiæ, Guér. Rev. Zool. 1841, p. 121.

Northern Island?

Trichosternus planiusculus, White, *l. c.* p. 3, t. 1. f. 7.

Northern Island.

Holcaspis angustula, Chaud. Bull. Mosc. 1865, iii. p. 99.

Omaseus elongatus, Blanch. Voy. Pôle Sud, Zool. iv. p. 28, t. 2. f. 4 (specific name preoccupied).

Christchurch. One example sent by Mr. Fereday. Found also at Akaroa.

Holcaspis sylvatica, Chaud. *l. c.* p. 100.

Omaseus sylvaticus, Blanch. *l. c.* p. 29, t. 2. f. 5.

Akaroa. I have three examples from Mr. Henry Edwards, but do not know their exact locality.

Holcaspis subænea.

Platysma subænea, Guérin, Rev. Zool. 1841, p. 122.
Feronia (Pterostichus) vagepunctata, White, *l. c.* p. 4.

Port Nicholson; also Christchurch.

I obtained an example from M. Doué's collection named *Platysma subænea*, which is evidently authentic, agreeing with the author's description and the types of *vagepunctata* of White.

Holcaspis œdicnema, n. sp.

H. subæneæ proxime affinis, sed maris femoribus posticis subtus medio valde dilatatis et dentatis. Subæneo-nigra, nitida; thorace magno, quadrato, postice perparum angustato, ante basin vix sinuato, angulis posticis paulo productis; elytris brevibus profunde striatis, striis punctatis et passim (præcipue postice) subinterruptis. Long. 8 lin. ♂.

Much resembling *H. subænea*; but the elytra are much

shorter and the thorax rather longer than in that species. The thorax is very nearly as long as broad, and is somewhat regularly and slightly rounded on the sides, the greatest width being in the middle; behind it is very much less sinuate, and the hind angles are less produced than in *subænea*; the basal fovea also is larger, and offers on its outer slope a distinct second smaller fovea; but some trace of this is visible in well-developed examples of *subænea*. The hind legs are remarkably short, and the femora are widely dilated beneath, forming a tooth, between which and the base is lodged the elongated trochanter.

One example; in my own collection. Exact locality unknown.

Holcaspis elongella, White, *l. c.* p. 4.

Christchurch. Several examples from Mr. Fereday.

Holcaspis ovatella, Chaud. Bull. Mosc. 1865, iii. p. 103.

Distinguished by its three punctures on the third interstice of the elytra; otherwise similar to *H. elongella*.

The precise locality of this distinct species (9 lines long) is not known. I have one example obtained from a New-Zealand collection, probably from the Southern Island.

The genus *Holcaspis* resembles in general form the parallel species of *Pterostichus*, having, like them, very short metathoracic episterna and the marginal stria of the elytra duplicated towards the apex. It is distinguished by the base of the scutellum being scored by a number of short fine lines; this character, however, is seen in some European species of the *Feronia* group—*e. g. Haptoderus abaxoides*, Dej., *Tapinopterus cephalotes*, Gaut., and others.

Haptoderus maorinus, n. sp.

H. oblongus, nigro-piceus, ♂ nitidus, ♀ elytris sericeo-subopacis; palpis, pedibus, antennisque plus minusve piceo-rufis; capite foveis frontalibus vix impressis; thorace quadrato, lateribus antico paulo rotundatis, post medium leviter sinuato-angustatis, angulis posticis paulo productis rectis, fovea basali utrinque unica profunda, toto impunctato; elytris postice paulo angustatis, apice haud sinuatis, striis profundis simplicibus, interstitio tertio bipunctato. Long. $3\frac{1}{2}$–$3\frac{3}{4}$ lin. ♂ ♀.

Christchurch (*C. M. Wakefield, Esq.*).

Similar in form to *Holcaspis sylvatica*, but wanting the essential character of the group—the striated base of the scutellum. In all essential characters it agrees with the European

Haptoderi. The palpi have the terminal joints narrowed to the tip and very briefly (the maxillaries in the male not at all) truncated. The head is rather small, and shows scarcely any trace of the usual frontal foveæ; the thorax has on each side of the base a single deep, almost sulciform, fovea, and its whole surface is impunctate. The elytra have a well-developed scutellar striole between the suture and the first stria; the interstices are plane in the subopaque female and a little more convex in the shining male, but in both sexes they become narrow and convex at the apex, and the first stria is continued round the apex to the marginal stria.

Argutor erythropus, Blanch., as far as the very insufficient description goes, agrees with this species; but no mention is made of the two punctures on the third interstice.

Argutor pantomelas, Blanch. Voy. au Pôle Sud, Zool. iv. p. 27, t. ii. f. 6.

8–9 millims. Rather broad, black; elytra nearly plane; palpi clear red; thorax with two lineiform foveæ on each side.

The description almost applies to the *O.* (*Holcaspis*) *sylvaticus* of the same author; and the species probably belongs to *Holcaspis.*

Argutor erythropus, Blanch. *l. c.* p. 27, t. ii. f. 7.

Probably a *Haptoderus.*

Argutor piceus, Blanch. *l. c.* p. 28, t. ii. f. 8.

The head is described as having two large rugose foveæ, and the elytra as ovate.

Feronia (*Platysma*) *vigil*, White, *l. c.* p. 3.

Nothing can be made of the superficial description given.

Feronia (*Platysma*) *politissima*, White, *l. c.* p. 4.

Port Nicholson.

The same remark as above applies to this species.

Molopsida polita, White, *l. c.* p. 6.

Waikouaiti.

I have not succeeded in finding the type of this insufficiently described genus and species in the British Museum.

Alogus monachicus, Motsch. Bull. Mosc. 1865, iv. p. 245.

7½ lines. Similar to *Omaseus* in form, but broader and

without scutellar striole. Metathoracic episterna a little longer than broad. Thorax nearly twice the width of the head, transverse, cordate, base on each side bisulcate; sides arcuated; hind angles prominent, acute. Elytra with one puncture on the third interstice.

I have seen no species agreeing with Motschulsky's description.

Cerabilia maori, Castelnau, *l. c.* p. 202.

Dunedin.

Belongs to the *Feronia* group, according to the author; but the mentum is described as without tooth, and the palpi as pointed. The species is 4½ lines long, brown, and elytra feebly striated.

Rhabdotus reflexus, Chaud. Bull. Mosc. 1865, iii. p. 94.

Notwithstanding the almost invariable accuracy of M. de Chaudoir, I suspect an error in the locality he gives to this species. The specimens I have seen are all from Tasmania.

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

The Naturalist in Nicaragua. By Thomas Belt, F.G.S. London: Murray.

This is another addition to that pleasant class of books of travel the type of which is Darwin's 'Journal of a Naturalist,' and which have acquired increased interest since the appearance of the 'Origin of Species.' Mr. Belt's special line of study appears to be mining geology, his mission in Nicaragua being the management of the gold-mines of Chontales, situated about midway between the Atlantic and Pacific sea-boards; but his observations range over other departments of geology and physical geography, and a taste for natural history, especially its philosophical side, led him to devote much of his leisure time to collecting and observing the plants and animals of the districts he visited. The result is a volume full of original observation and vigorous reasoning. Some of the reasoning, in fact, is likely to be considered too bold; but it displays the working of an original mind, well stored with accurate knowledge, and endeavouring to explain some of the knottiest problems in physical science. As a narrative of travel the book is agreeable reading, without, perhaps, having that fascination which other works of the same class, containing more exciting personal experience and dealing with regions of more intrinsic interest, are found to possess. There are not

wanting, however, descriptive passages of considerable power and truthfulness; and many of the general observations and reflections scattered throughout the work are instructive and sound.

The mode in which Mr. Belt handles the subject of the glacial epoch, and the influence it had upon the distribution of plants and animals, may be selected as an illustration of the above remarks. In the course of a journey he took to the mountainous district near Ocotal, on the northern frontier of Nicaragua, he discovered an extensive deposit of unstratified gravel with boulders, which, he had no doubt, formed the moraine of a huge glacier, at an altitude of not more than 2000 to 3000 feet above the present sea-level. The deposit had been worn through by streams, in some places to the depth of 200 feet, exposing numerous vertical sections; and, with the single exception of striated surfaces, he observed all the same signs of glacial action which he had studied in Wales, Scotland, and Nova Scotia. Reasoning from this and other evidence which he adduces, he first states the grounds on which he thinks it must be concluded that the phenomena were due to glacier ice and not to icebergs; and he then draws the inference that the whole of the high land between the tropics must have been, during the glacial epoch, covered with snow and ice. A similar conclusion, as is well known, had been arrived at before by other writers; but no one had hitherto offered a satisfactory explanation of the non-extinction, in that state of things, of the vast host of peculiar forms of plants and animals still existing in the equatorial lowlands. Mr. Belt, in accounting for this, adopts and extends an hypothesis of Mr. Alfred Tylor, to the effect that the quantity of water locked up in the polar ice-cap lowered the level of the sea to the extent of 600 feet. He believes the depression would exceed 1000 feet, and that the tracts of sea-bottom thereby laid bare would form a refuge for the equatorial fauna and flora. The hypothesis is not fully worked out; and it would be necessary, before it can be seriously dealt with, to explain the climatal conditions of the lowlands between the tropics at a time when all the elevated land was subject to arctic rigour. One obvious consideration he has certainly omitted to note, viz. that a lowering of the sea by 1000 feet would act on climate chiefly by making all the land virtually 1000 feet higher, as the atmosphere, being constant in total amount, would descend with the lowering of the sea-level. This would produce a train of consequences in a high degree favourable to the state of things Mr. Belt supposes to have existed.

With regard to its other effects on the distribution of plants and animals, he ingeniously points out how the laying bare of shallow seas, such as those separating Borneo and the neighbouring islands from continental Asia, would account for the present existence of so many species and genera of terrestrial animals in lands now separated from each other. He goes, however, too far in reviving the fabled Atlantis. Whatever we may think of this hypothesis in the form too briefly sketched out by Mr. Belt, there can be no doubt of its great suggestiveness, and of the justness of his view in requiring

that any such theory shall fit the known facts of biology as well as those of geology and physics.

Some of the most interesting of Mr. Belt's zoological observations relate to ants, of whose habits he was evidently a close observer. Thus with regard to the *Œcodomæ*, or leaf-cutting ants, he is the first to record any thing of the internal economy of their vast subterranean dwellings. He had to do battle with these fearful depredators in his attempts to cultivate various useful and ornamental plants in his garden, and gives an amusing description of his endeavours to extirpate them by pouring buckets-full of diluted carbolic acid down the broad passages which lead to their cavernous abodes. But the most extraordinary thing he relates of them is that their habitual food is a fungus, which they sedulously grow in their underground chambers. In fact, it is for this purpose, he found, that they require the vast quantity of pieces of leaves which the workers spend nearly all their lives in cutting from young trees and carrying to their abodes—the leaves not being used as food, nor as a thatch for their nests, as had been surmised by other writers, but being stored in chambers, where, in decaying, they produce a minute fungus, on which the larvæ and small workers seem to feed. He gives also many interesting details regarding the various species of *Eciton*, or foraging ant, which hunt through the Tropical-American forests in large armies, and states a fact which is entirely new, viz. that they construct no formicarium, but have only temporary abodes. The facts cited in illustration of the reasoning-powers of ants are numerous throughout the volume; it is a subject on which he tried many experiments with curious results. The best case he gives is that of a marauding procession of *Œcodomæ* tunnelling under the rails of a tramway to avoid being crushed by the passing waggons. One day when the waggons were not running, Mr. Belt stopped up their tunnel with stones; but although great numbers were thus cut off from their nest, they would not cross the rails, but set to work making fresh tunnels underneath them. It is impossible to do more than allude to the vast store of suggestive facts and reasoning on this subject contained in the volume.

The relations of insects to flowers in regard to cross-fertilization form the subject of many original observations, recorded and argued out to definite conclusions with great keenness and circumspection. The same may be said with reference to another less-worked phase of insect- and plant-relationship, viz. the special adaptations of leaves to attract pugnacious ants as defenders of the plants against defoliation by leaf-cutting ants, caterpillars, and other phytophagous animals. This subject is dealt with in a series of observations on the bull's-horn-thorn Acacia, on species of *Melastoma* having glandular swellings at the bases of their leaves containing a sweet fluid to attract ants, and on the *Cecropia* trees, which invite protecting ants to dwell in their hollow chambered stems. The ants thus attracted form, as Mr. Belt expresses it, a most efficient standing army for the plant.

Mimetic resemblances come in for a large share of Mr. Belt's

attention. He had commenced his observations in Nicaragua with the advantage of some previous knowledge of the subject, and was therefore prepared to direct his inquiries to many points that required elucidation before the Darwinian explanation of these phenomena can be said to be established. Thus we find recorded his experiments on living insects which are the objects of mimicry by other forms, as to their distastefulness as food to insectivorous animals. Whenever he observes an instance of mimetic resemblance, he reasons out its causes and conditions instead of merely stating it. One of the most striking cases he mentions is that of a green leaf-like locust, which almost alone of all other living things stood its ground amid a destroying host of foraging ants. It stood immovable whilst the ants ran over its legs, and allowed him to pick it up and replace it amongst the ants without making an effort to escape. It might easily have flown away; but it would then only have fallen into as great a danger; for the numerous birds that accompany the army-ants are ever on the outlook for any insect that may fly up. Another case is that of a Longicorn beetle, belonging to a genus the species of which resemble various other objects: those members of the genus which live on dead wood are coloured so as to resemble lichen-stained bark: but one species (*Desmiphora fasciculata*) resembles a brown hairy caterpillar; and this he found only on leaves.

Mr. Belt's numerous observations on birds, as well as those on the few mammals he met with, are marked by the same originality and suggestiveness. His charming descriptions of the habits and haunts of humming-birds will attract many readers besides ornithologists. The use of the expanded white tail of the *Florisuga mellivora* in courtship (p. 112), which he fortunately had opportunities of observing, will be a welcome fact to the partisans of the Sexual Selection hypothesis. The volume, besides, contains abundant contributions to the general physical geography of the country (his remarks on the retrocession of the frontier of the virgin forest being especially worthy of attention) and to the ethnology of Nicaragua and neighbouring countries.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 19, 1873.—William Spottiswoode, M.A., Treasurer and Vice-President, in the Chair.

"On the Structure and Development of the Skull in the Pig (*Sus scrofa*)." By W. K. Parker, F.R.S.

I have for some years past determined to concentrate my attention on some one type of Mammalian Skull, so as to be able to present to the Royal Society a paper similar to those which have

already appeared on other Vertebrate Skulls. I was led to work out this MEDIUM TYPE, and not a more generalized form, such as the Guinea-pig (see "On the Development of the Frog's Skull," Phil. Trans. 1871, p. 203), through the circumstance of an offer from my friend Mr. Charles Stewart to put some seventy embryos of the Common Pig into my possession. In the present communication I have had the invaluable help of advice and oversight from Professor Huxley; whilst the labour of my hands has been lightened by my son, Mr. T. J. Parker, who prepared for me all the more delicate sections. The embryos ranged in size from two thirds, or less, of an inch in length, with the head only equal in size to a *sweet pea*, whilst the head of the largest specimen was the size of that of the Common Squirrel. To these I have added young pigs at birth, and have taken as the last stage the skull of a half-grown individual.

The most important results of the present investigation may be stated as follows:—

1. In a pig-embryo, in which the length of the body did not exceed two thirds of an inch, and four postoral clefts were present, the cranio-facial skeleton was found to consist of:—(*a*) the notochord, terminating by a rounded end immediately behind the pituitary body.

(*b*) On each side of the notochord, but below it, there is a cartilaginous plate, which in front ends by a rounded extremity on a level with the apex of the notochord, while behind it widens out and ends at the free lower margin of the occipital foramen. These two plates, taken together, constitute the "investing mass" of Rathke. In this stage they send up no prolongations around the occipital foramen; in other words, the rudiment of the basioccipital exists, but not of the exoccipital or superoccipital.

(*c*) The large oval auditory capsules lie on each side of the anterior half of the investing mass, with which they are but imperfectly united: there is no indication of the stapes at this stage.

(*d*) The *trabecular* or first pair of præoral visceral arches inclose a lyre-shaped pituitary space; they are closely applied together in front of this space, and, coalescing, give rise to an azygous prænasal rostrum. They are distinct from one another and the investing mass.

(*e*) The *pterygo-palatine* or second pair of visceral arches lie in the maxillo-palatine processes, and are therefore subocular in position. Each is a sigmoid bar of nascent cartilage, the incurved anterior end of which lies behind the internal nasal aperture, while the posterior extremity is curved outwards about the level of the angle of the mouth. The pterygo-palatine cartilages are perfectly free and distinct from the first præoral and from the first *postoral* arch.

(*f*) The *mandibular* or first pair of postoral visceral arches are stout continuous rods of cartilage which lie in the first visceral arch behind the mouth. The ventral or distal ends of these arches are not yet in contact; the dorsal or proximal end of each is somewhat pointed and sharply incurved, pushing inwards the

membrane which closes the first visceral cleft and is the rudiment of the membrana tympani.

(*g*) The *hyoid* or second pair of postoral arches are in this stage extremely similar to the first pair, with which they are parallel. They are stout sigmoid rods of cartilage, which are separated at their distal ends, present an incurved process at their opposite extremities, and are not segmented.

(*h*) The *thyro-hyal* or third postoral arches, which correspond with the first branchial of the branchiate vertebrata, are represented by two short cartilaginous rods which lie on each side of the larynx.

(*i*) The olfactory sacs are surrounded by a cartilaginous capsule, which has coalesced below with the trabecula of its side; while, within, the mucous membrane lining the capsule presents elevations which indicate the position of the future turbinal outgrowth of the capsule.

In this stage the posterior nares are situated at the anterior part of the oral cavity, as in the Amphibia, and the roof of the mouth is formed by the floor of the skull, the palatal plate of the maxillæ and palatine bones being foreshadowed by mere folds. The outer end of the cleft between the first and second præoral arches is the rudiment of the lachrymal duct, while its inner end is the hinder nasal aperture. The gape of the mouth is the cleft between the second præoral and first postoral arch. The auditory passage, representing the Eustachian tube, tympanum, and external auditory meatus, is the cleft between the first and second postoral arches. The proximal end of the mandibular arch, therefore, lies in the front wall, and the hyoid in the hinder wall of the auditory passage.

2. In an embryo pig, an inch in length, (*a*) the notochord is still visible; (*b*) the investing mass, the halves of which are completely confluent, has become thoroughly chondrified, and is continued upwards at each side of the occipital foramen to form an arch over it.

(*c*) The auditory capsules are still distinct from the investing mass, and a plug on the outer cartilaginous wall of each has become marked off as the stapes.

(*d*) The hinder ends of the trabecular arches have coalesced in front of the pituitary body, but they are not yet confluent with the investing mass.

(*e*) The pterygo-palatine rods have increased in size; they have not become hyaline cartilage, but are beginning to ossify in their centre.

(*f*) In the mandibular arch the proximal end has become somewhat bulbous, and is recognizable as the head of the malleus, whilst the incurved process, still more prominent than before, is the *manubrium mallei*. The rest of the arch is Meckel's cartilage; outside this a mass of tissue appears, which is converted into cartilage, rapidly ossifies, and eventually becomes the ramus of the mandible.

(*g*) The proximal end of the hyoidean arch, similarly enlarging and articulating with the corresponding part of the mandibular arch, becomes the incus, the incurved process attaching itself to the outer surface of the stapes and becoming the long process of the incus. The incus, thus formed out of the proximal end of the hyoidean arch, becomes separated from the rest of the arch by conversion of part of the arch into fibrous tissue, and by the moving downwards and backwards of the proper hyoid portion of the arch. A nodule of cartilage left in the fibrous connecting band becomes a styliform *interhyal* cartilage, while the proximal end of the detached arch becomes the *stylo-hyal*.

(*h*) The *thyro-hyals* have merely increased in size and density; they closely embrace the larynx by their upper ends.

(*i*) The olfactory capsules are well chondrified; their descending inner edges have coalesced with each other and, below, with the trabeculæ to form the great median septum. the turbinal outgrowths are apparent.

In this stage, the alisphenoids and orbito-sphenoids appear as chondrifications of the walls of the skull, quite separate from the investing mass and from the trabeculæ.

The floor of the pituitary space chondrifies independently of the trabeculæ and investing mass, but serves to unite these four cartilaginous tracts.

3. In an embryo pig, 1½ inch in length, (*a*, *b*, *c*) the primordial cranium is completely constituted as a cartilaginous whole, formed by the coalescence of the investing mass and its exoccipital and superoccipital prolongations, the modified trabeculæ, the subpituitary cartilage, the auditory capsules, and alisphenoidal and orbito-sphenoidal cartilages, and the olfactory capsules. The notochord is yet to be seen extending in the middle line from the hinder wall of the pituitary fossa (now the "*dorsum sellæ*") to the posterior edge of the occipital region.

(*d*) The trabecular arches form the sides of the sella turcica, the præsphenoid, and the base of the septum between the olfactory capsules; in front, where they form the azygous "prænasal," they are developed backwards as "recurrent bands," elongations of their free recurved "cornua."

(*e*) The pterygo-palatine arches, still increasing in size, but not chondrifying, are rapidly ossifying; they are half-coiled laminæ bounding the posterior nasal passages.

(*f*) The mandibular arch and the rudimental ramus have become solid cartilage, and the latter is ossifying as the dentary; the distal part of each mandibular rod unites with its fellow for some distance.

(*g*) The hyoid arches are each fully segmented as incus, with its "orbicular" head, interhyal, stylo-hyal, and cerato-hyal.

(*h*) The thyro-hyals are merely larger and denser.

(*i*) The olfactory capsules have the turbinal outgrowths all marked out as alinasal, nasal, and upper, middle, and lower turbinals.

4. In pigs of larger size the form and proportions of the parts of the cranium become greatly altered, and ossification takes place on an extensive scale, but no new structure is added.

5. It follows from these facts that the mammalian skull, in an early embryonic condition, is strictly comparable with that of an Osseous Fish, a Frog, or a Bird at a like period of development, consisting as it does of

(*a*) A cartilaginous basicranial plate embracing the notochord, and, like it, stopping behind the pituitary body.

(*b*) Paired cartilaginous arches, of which two are præoral, while the rest are postoral.

(*c*) A pair of cartilaginous auditory capsules.

(*d*) A pair of cartilaginous nasal capusles.

Further, that in the Mammal, as in the other Vertebrata the development of the skull of which has been examined, the basicranial plate grows up as an arch over the occipital region of the skull, and coalesces with the auditory capsules, laterally, to give rise to the primordial skeleton of the occipital, periotic, and basisphenoidal regions of the skull. The trabeculæ become fused together, and, uniting with the olfactory capsules, give rise to the præsphenoidal and ethmoidal parts of the cranium; and the moieties of the skull thus resulting from the metamorphosis of totally different morphological elements become united and give rise to the primordial cranium.

As in the Salmon and Fowl, the second pair of præoral arches give rise to the pterygo-palatine apparatus; in the Frog this arch is late in appearance, and is never distinct from the trabecular and mandibular bars, serving as a conjugational band between them. The mandibular arch, which in the Salmon becomes converted into Meckel's cartilage, the os articulare, the os quadratum, and the os metapterygoideum, in the Frog into Meckel's cartilage and the quadrate cartilage (which early becomes confluent with the periotic capsule), in the Bird into Meckel's cartilage, the os articulare, and the os quadratum (which articulates movably with the periotic capsule), in the Pig is metamorphosed into Meckel's cartilage and the malleus, which is loosely connected with the tegmen tympani, an outgrowth of the periotic capsule.

Meckel's cartilage persists in the Fish and in the Amphibia, but disappears early in the Bird, and still earlier in the Mammal. The permanent ossifications of the mandible are all membrane-bones in Fish, Frog, and Fowl, but in the Mammal (exceptionally) the ramus has a cartilaginous foundation. The hyoidean becomes closely united with the mandibular arch, and then segmented, in the Fish, into the hyo-mandibular, the stylo-hyal, cerato-hyal, and hypohyal—the hyo-mandibular, or proximal segment, articulating with the outer wall of the periotic, and many of the segments of the arch becoming dislocated.

In the Frog, the hyoid also becomes segmented, but only after extensive coalescence with the mandibular arch. The proximal segment becomes the suprastapedial (hyo-mandibular) with its ex-

trastapedial process, and, extending inwards as mediostapedial and interstapedial, articulates with the stapes, developed by segmentation from the outer wall of the auditory capsule. The stylo-hyal is dislocated and becomes connected with the auditory capsule below the stapes (opisthotic region).

In the Bird, the hyoidean arch remains distinct from the mandibular. Whilst in its primordial condition it coalesces by its incurved apex with the auditory capsule in front of the promontory, before the stapedial plug is segmented. It then chondrifies as three distinct cartilages—an incudal, a stylo-hyal, and, distally, a cerato-hyal. The stapes becomes free from the auditory capsule, but remains united with the cartilaginous part of the incus (mediostapedial); the ascending part is largely fibrous (suprastapedial), and the part loosely attached to the mandibular arch is the elongated extrastapedial. The short stylo-hyal afterwards coalesces with the body of the upper or incudal segment by an aftergrowth of cartilage (the *interhyal* tract); a long membranous space intervenes between it and the glossal piece (cerato-hyal.) Thus the "columella" of the Bird is formed of one periotic and three hyoidean segments.

In the Pig, the hyoidean arch is distinct, but articulates closely with the mandibular; its upper segment (hyo-mandibular) is converted into the incus, and becomes connected with the stapes. The stylo-hyal is dislocated and coalesces with the opisthotic region of the auditory capsule.

December 18, 1873.—Joseph Dalton Hooker, C.B., President, in the Chair.

"On the Nervous System of *Actinia*."—Part I. By Professor P. Martin Duncan, M.B. Lond., F.R.S., &c.

After noticing the investigations of previous anatomists in the histology of the chromatophores, the work of Schneider and Rötteken on these supposed organs of special sense is examined and criticised.

Agreeing with Rötteken in his description, some further information is given respecting the nature of the bacillary layer and the minute anatomy of the elongated cells called "cones" by that author. The position and nature of the pigment-cells is pointed out, and also the peculiarities of the tissues they environ. It is shown that the large refractile cells, which, according to Rötteken, are situated between the bacilli and the cones, are not invariably in that position, but that bacilli, cones, and cells are often found separate. They are parts of the ectothelium, and when conjoined enable light to affect the nervous system more readily than when they are separate. Further information is given respecting the fusiform nerve-cells and small fibres noticed by Rötteken in the tissue beneath the cones; and the discovery of united ganglion-like cells and a diffused plexiform arrangement

of nerve is asserted. The probability of a continuous plexus round the *Actinia* and beneath each chromatophore is suggested, and the physiological action of the structures in relation to light is explained.

The minute structure of the muscular fibres and their attached fibrous tissue in the base of *Actinia* is noticed; and the nervous system in that region is asserted to consist of a plexus beneath the endothelium, in which are fusiform cells and fibres like sympathetic nerve-fibrils. Moreover, between the muscular layers there is a continuation of this plexus, whose ultimate fibrils pass obliquely over the muscular fibres, and either dip between or are lost on them.

The other parts of the *Actinia* are under the examination of the author, but their details are not sufficiently advanced for publication. The nervous system, so far as it is examined, consists of isolated fusiform cells with small ends (Rottoken), and of fusiform and spherical cells which communicate with each other and with a diffused plexus. The plexus at the base is areolar; and its ultimate fibres are swollen here and there, the whole being of a pale grey colour.

MISCELLANEOUS.

Occurrence of Gigantic Cuttlefishes on the Coast of Newfoundland. By A. E. Verrill.

Considerable popular interest has been excited by several articles that have recently been published and extensively circulated in the newspapers of Canada and the United States, in regard to the appearance of gigantic "squids" on the Newfoundland coast. Having been so fortunate as to obtain, through the kindness of Professor S. F. Baird, the jaws and other parts of two of these creatures, and, through the courtesy of Dr. J. W. Dawson, photographs of portions of two other specimens, I have thought it worth while to bring together, at this time, the main facts respecting the several specimens that have been seen or captured recently, so far as I have been able to collate them, reserving for a future article the full descriptions and figures of the jaws and other portions now in my possession.

We now have reliable information concerning five different examples of these monsters that have appeared within a short period at Newfoundland.

1. A specimen found floating at the surface, at the Grand Banks, in October 1871, by Captain Campbell, of the schooner 'B. D. Haskins,' of Gloucester, Mass. It was taken on board, and part of it used for bait. Dr. A. S. Packard has given, in the 'American Naturalist,'

vol. vii. p. 91, Feb. 1873, all the facts that have been published in regard to this individual. But its jaws have since been sent to the Smithsonian Institution, and are now in my hands to be described and figured. They were thought by Professor Steenstrup, who saw a photograph of them, to belong to his *Architeuthis monachus*, which inhabits the northern coasts of Europe, but is still very imperfectly known. The horny jaw or beak from this specimen is thick and strong, nearly black; it is acute at the apex, with a decided notch or angle on the inside, about ·75 of an inch from the point; and beyond the notch is a large prominent angular lobe. The body of the specimen from which this jaw was taken is stated to have measured 15 feet in length and 4 feet 8 inches in circumference. The arms were mutilated; but the portions remaining were estimated to be 9 or 10 feet long, and 22 inches in circumference, two being shorter than the rest. It was estimated to weigh 2000 pounds.

2. A large individual attacked two men, who were in a small boat, in Conception Bay; and two of the arms which it threw across the boat were cut off with a hatchet and brought ashore. Full accounts of this adventure, written by Mr. M. Harvey, have been published in many of the newspapers*. One of the severed arms, or a part of it, was preserved in the museum at St. John's; and a photograph of it is now before me. This fragment represents the distal half of one of the long tentacular arms, with its expanded terminal portion covered with suckers, 24 of which are larger, in two rows, with the border not serrate, but 1·25 inch in diameter; the others are smaller, very numerous, with the edge supported by a serrated calcareous ring. The part of the arm preserved measured 19 feet in length, and 3·5 inches in circumference, but wider, "like an oar," and 6 inches in circumference, near the end where the suckers are situated; but its length, when entire, was estimated at 42 feet†. The other arm was destroyed, and no description was made; but it was said to have been 6 feet long and 10 inches in diameter; it was evidently one of the eight shorter sessile arms. The estimate given for the length of the "body" of this creature (60 feet) was probably intended for the *entire length*, including the arms.

3. A specimen was found alive in shallow water, at Coomb's Cove, and captured. Concerning this one I have seen only newspaper accounts. It is stated that its body measured 10 feet in length and was "nearly as large round as a hogshead" (10 to 12 feet); its two long arms (of which only one remained) were 42 feet in length and "as large as a man's wrist;" its short arms were 6 feet in length, but about 9 inches in diameter, "very stout and strong;" the suckers had a serrated edge. The colour was reddish. The loss of one long arm and the correspondence of the other in size to the one amputated from No. 2, justifies a suspicion that this was actually

* Also in the 'Annals and Magazine of Natural History,' January 1874, with a woodcut of the arm.

† Doubtless these long arms are very contractile and changeable in length, like those of the ordinary squids.

the same individual that attacked the boat. But if not, it was probably one of the same species and of about the same size.

4. A pair of jaws and two of the suckers were recently forwarded to me from the Smithsonian Institution. These were received from Rev. A. Munn, who writes that they were taken from a specimen that came ashore at Bonavista Bay, that it measured 32 feet in length (probably the entire length, including more or less of the arms), and about 6 feet in circumference. This jaw is large and broad, but much thinner than that of No. 1, and without the deep notch and angular lobe seen in that specimen. It probably belongs to the *Architeuthis dux* of Steenstrup, or at least to the same species as the jaw figured by Dr. Packard.

5. A smaller specimen, captured in December, in Logie Bay, about 3 miles from St. John's, in herring-nets. Of this I have a description in a letter to Dr. Dawson from the Rev. M. Harvey, who has also published a brief account of it in the 'Morning Chronicle' of St. John's. The letter is accompanied by two photographs of the specimen—one showing the entire body, somewhat mutilated anteriorly, the other showing the head with the ten arms attached. The body of this specimen was over 7 feet long, and between 5 and 6 feet in circumference; the caudal fin was 22 inches broad, but short, thick, and emarginate posteriorly on each side, the end of the body being acute; the two long tentacular arms were 24 feet in length, and $2\frac{1}{2}$ inches in circumference, except at the broader part near the end, the tips slender and acute; the largest suckers 1·25 inch in diameter, with serrated edges; the eight short arms were each 6 feet long; the two largest were 10 inches in circumference at base, the others were 9, 8, and 7 inches. These short arms taper to slender acute tips; and each bears about 100 large, bell-shaped suckers with serrated margins. Each of the long arms bears about 160 suckers on the broad terminal portion, all of which are denticulated; the largest ones, which form two regular alternating rows of twelve each, are about an inch in diameter. There is also an outer row of much smaller suckers, alternating with the large ones, on each margin; the terminal part of these arms is thickly covered with small suckers; and numerous similar small suckers are crowded on that portion of the arms where the enlargement begins, before the commencement of the rows of large suckers. The arrangement of the suckers is nearly the same as on the long arm of No. 2; but in the latter the terminal portion of the arm, beyond the large suckers, as shown in the photographs, is not so long, tapering, and acute; but this may be due to the different conditions of the two specimens. It is probable that this was a young specimen of the same species as No. 2.

From the facts known at present, it appears probable that all these specimens, and several others that have been reported at various times from the same region, are referable to two species—one (probably *Architeuthis monachus*) represented only by the first of those enumerated above, and having a more elongated form of body and stouter jaws; the second (probably *A. dux*) represented by

Nos. 2 to 5, above described, having a short, thick, massive body, and broad, but comparatively thin jaws, which are also different in form. Some of the differences in size and proportions, and in the suckers, observed among the four specimens referred to the latter species may be due to sex; for the sexes differ considerably in these characters in all known cuttlefishes.—*American Journal of Science and Arts*, Feb. 1874.

Umbellula *from Greenland*. By Joshua Lindahl.

Mr. Lindahl has written a paper on the two specimens of *Umbellula* taken on the coast of Greenland. It will appear in the next volume of the 'Kongl. Vetenskaps-Akad. Handlingar' of Stockholm, illustrated with three quarto plates, each containing several figures.

Mr. Lindahl considers the two specimens different from one another and from the *Umbellula encrinus* of Linnæus figured by Mylius and Ellis. He observes he must confess that the difference may depend upon the difference of age, and as for *U. encrinus* upon imperfection in the figure and description. At all events, he thinks it better to describe his two specimens as two different and new species in order to call attention to the differences, observing "that when new investigations of the deep sea have brought together richer materials, as no doubt they will, if I have committed a mistake in this respect it will be easily corrected." He considers that *Umbellula* and *Crinillum* form one group, as Dr. Gray has pointed out. He regards them as true Pennatulids, and puts them among the "Zunft" Pennatulidæ as the fifth family, *Umbellulæ*, close to the family *Bathyptileæ* (Kolliker, 'Die Pennatuliden,' p. 380). The rachis, or *pars polypifera*, is about one fortieth of the length of the stem; polypes not retractile, without calycles, the lateral ones large and the dorsal small; the zooids are crowded in lateral and ventral shields ("Wülste," Koll.); the axis square, with one deep groove on each side; no spicula in any part of body.

On the Bos pumilus *of Sir Victor Brooke*. By Dr. J. E. Gray, F.R.S. &c.

Sir Victor Brooke's paper in the last number of the 'Annals' shows that he does not understand the question between us, and it contains many erroneous statements. I will therefore state the question as shortly as I can.

Sir Victor Brooke states at p. 159:—"Turton, having founded the name *Bos pumilus* upon Pennant's 'Dwarf,' it follows that the horns spoken of and figured by Pennant are typical specimens of '*Bos pumilus*.'" The statement that the fragment of the forehead and horns are typical of Pennant's "Dwarf," and therefore of the *B. pumilus* of Turton, who never refers to the specimen, is entirely inaccurate, as the following statement will prove.

Columna figured a buffalo from Morocco. Pennant and Turton abbreviated his description and called it the dwarf buffalo and *Bos*

pumilus, thus making it the type of their species. The forehead and horns of a young ox were in the Museum of the Royal Society. Pennant thought that they belonged to his dwarf buffalo, but in his second edition said that he *now* found that they belonged to the Cape ox. Turton, in his account of *Bos pumilus*, made no reference to these horns, which Sir Victor Brooke says (but I do not think he has proved it) are the horns of a young *Bos brachyceros* of Western Africa, and proposes to change the name of this ox to *Bos pumilus* of Turton, established on an *animal* from Morocco, and *not*, as Sir Victor Brooke asserts in his paper, on *the forehead and horns* in the Museum of the Royal Society, the existence of which Turton does not notice. The animal from Morocco he named *B. pumilus* is supposed to be a young or dwarf variety of the common buffalo, and is certainly not the West-African bush-ox (*Bos brachyceros*).

If Sir Victor Brooke cannot see the mistake he has made, I have done my best to enable him to do so; and it is this non-appreciation of such questions that renders his prolix synonymy in various cases useless and misleading.

On Felis colocolo, *Hamilton Smith, F. Cuvier, and Geoffroy.* By Dr. J. E. Gray, F.R.S. &c.

Major Hamilton Smith made a figure of an animal "said to have been shot in the interior of Guiana by an officer of Lewenstein's Riflemen, and by him stuffed and sent to England, but which probably never reached its destination." It is represented as a white cat, with various-sized longitudinal brown dashes on its neck and body, with slate-coloured legs and feet, and a slender black tail with numerous white rings.

Of this drawing an account was published in Griffith's 'Animal Kingdom,' in Geoffroy and Cuvier's 'Histoire Naturelle des Mammifères' (where the animal is said to come from Surinam), and in Jardine's 'Naturalist's Library,' iii. p. 256, pl. xxvi., where the legs are erroneously left pale-coloured, though said to be blackish in the description.

I have never seen this cat, and I am not aware of its ever having been seen or of its being in any museum in Europe. It certainly is not the *Felis colocolo* of Molina, from Chili, figured by Philippi, Wiegmann's 'Archiv,' 1870, p. 41, t. i. fig. 7, and t. iii. figs. 1 & 2.

My late friend and teacher, Colonel Hamilton Smith, drew animals most beautifully and with great facility, and made a very large collection of sketches and drawings of them and of antiquities and costumes, which he collected from museums that he visited, and books, and even fragments of skins. Unfortunately, instead of drawing the specimen or the figure of the animal which he examined as it was, he had the habit of improving its attitude, and even of making a beautiful drawing from a bad specimen, or from a fragment of a skin, or from a rough sketch, or from a woodcut or other figure which he found in some old book; and he very often did not mark his drawings whence or how they were obtained; so

that it was difficult to tell their authority. He seldom finished or coloured his sketches at the time he made them, but would mark on the parts of the drawing with the colour that they ought to be (as "red," "white," "black") without indicating the shade. This explains why the figures which are taken from his sketches in the first volume of Jardine's 'Naturalist's Library' (1842) were so erroneously coloured, and makes the determination of some of his figures doubtful. It was this defect that rendered his beautiful and extensive series of sketches of so little value to the zoological student.

On some Remarkable Egg-sacs on an Annelid from the North Sea. By Prof. Karl Mobius.

Several specimens of *Scolecolepis cirrata*, Sars, were captured in the expedition of the 'Pommerania' on the 6th August, 1872, at a depth of 69 fathoms, to the north-east of Scotland. This worm belongs to the family Spioidei. The body-segments are 2·4 millims. broad and 4 millims. deep; they have on each side a foot composed of a large upper and a smaller lower lamina. On the 28 segments of the fore body linguliform branchiæ with long vibratile cilia are placed at the inner border of the upper foot-laminæ. The hinder segments have no branchiæ. All the segments bear long pointed setæ both on the upper and lower foot-plates; on the lower laminæ of the hinder segments there are also uncini; and below and between them some small pouches, having the form of a swallow's nest, are attached. Many of these pouches contain a round mass of eggs, which often projects far beyond the orifice of the pouch. The eggs protruding from the pouches are held together by a net with quadrangular meshes, formed of cords of extremely fine threads. Before the pouches are filled with eggs this net lies in part like a lining within its pouch, and in part on the skin of the worm between the foot-laminæ. As the latter contain many mucus-glands with fine orifices opening externally, we may assume that these glands form the net. The eggs are produced in the body-cavity of the worm, and issue through apertures which traverse the body-wall between the lower foot-laminæ; they then lift the ready prepared net from the skin, and are retained by it upon the body of the worm. The young animals which are developed from the [illegible] can slip out into the water through the meshes of the net.

We know of many Polychætous Annelids which bear their [illegible] and young in a sac attached to the ventral surface (e. g. *Autolytus prolifer*, Müll.), one which carries them on the shorter dorsal filaments of its feet (*Syllis pulligera*, Krohn), and one which conceals them beneath folds of skin, developed on the peduncle of the operculum with which it closes its tube (*Spirorbis spirillum*, Pagenst.); but the peculiar arrangement for the protection of the progeny seen in *Scolecolepis cirrata* was previously unknown.—*Schriften des naturwiss. Vereins für Schleswig-Holstein*, Band i., February 2, 1874.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 76. APRIL 1874.

XXXIV.—*On the Annelida of the Gulf of St. Lawrence, Canada.* By W. C. M'Intosh.

Family 1. Euphrosynidæ, to Family 6. Sigalionidæ.

[Plates IX. & X.]

The following remarks are due to collections made by Mr. J. F. Whiteaves of Montreal during three dredging-expeditions (1871, 1872*, and 1873) in the Gulf of St. Lawrence; and I am much indebted to him for his courtesy in forwarding the specimens for examination.

No example of the first two families, viz. the Euphrosynidæ and Amphinomidæ, occurs. The Aphroditidæ are represented by several young examples of *Aphrodita aculeata*, L., which are of a somewhat ferruginous hue, like some Zetlandic specimens. The ventral bristles of these young forms resemble those of *A. alta*, Kinberg. One or two examples of *Lætmonice filicornis*, Kbg., a species very abundant in certain parts of the British seas, are also present†. The Polynoidæ are more numerous, and the majority of comparatively large size. *Lepidonotus squamatus*, L., is abundant; and the same may

* *Vide* Ann. Nat. Hist. 4th ser. vol. x. p. 341, 1872. Also 'Report on a second Deep-sea Dredging,' &c., by J. F. Whiteaves, Montreal, 14th January, 1873, pp. 22.

† Prof. Verrill mentions "*Hermione hystrix* (?)" from the coast of New England, but not this form. Americ. Journ. Sci. & Arts, vol. v. Feb. 1873.

be said of *Nychia cirrosa*, Pall. The specimens of the latter have somewhat rougher scales, and a tendency to a longer and more slender tip in the ventral bristles than the British forms. The latter feature is carried to a characteristic degree in *Nychia Amondseni*, Mgrn., a northern species (not yet discovered in British waters) rather plentiful in the collections. In this form the head differs from that of *N. cirrosa* chiefly in the smaller size of the eyes, especially the posterior pair. The dorsal cirri are longer; but the dorsal bristles are similar, except, perhaps, that the contrast between the shortest and the most elongated is better marked. The ventral bristles are much more attenuated at the tips throughout; and the smooth portion, while little longer in the superior series (though, of course, much more slender), becomes remarkably elongated in the central and lower groups. A specimen of *Selenium polynoës*, Kröyer, was attached to the ventral aspect of a foot.

Eunoa Œrstedi, Mgrn.,

occurred on Orphan Bank, and is distinguished roughly from the more common *E. nodosa*, Sars, likewise in the collection, by the brighter brownish coloration in spirit, by the much rougher scales, and the greater length of the dorsal bristles. Malmgren's figures are much in need of amendment, especially his representation of the dorsal bristles.

Lagisca rarispina, Sars, var. *occidentalis* *.

At first sight, and with an imperfect specimen without scales, the form was considered closely allied to *Polynoë floccosa*, Sav.; but further examination of more perfect examples showed the true character of the annelid. The scales are distinguished by the remarkably long, brownish, soft papillæ posteriorly, and have many parasitic *Loxosomæ* and other structures. The cilia on the dorsal cirri are much less numerous and shorter than on the species from the 'Porcupine' (*Lagisca Jeffreysii*); and the ventral cirri have a few short papillæ: the latter are stated by Malmgren to be subglabrous. The dorsal bristles (Pl. IX. fig. 1) are rather long, tapered towards the point, and with somewhat fine rows of spikes. The smooth part at the tip is of moderate length; but it often seems longer than it really is, since the rows of spikes pass far up; in certain views it is also slightly dilated, so as to give a character to the bristles. The superior ventral bristles

* The generic names in this paper are merely provisional, as very considerable changes will be necessary throughout the whole series of the Annelida in this respect.

(Pl. IX. fig. 2) have elongated tips with a trace of a secondary process; and the spiniferous region is long. The smooth tip becomes more boldly marked inferiorly (Pl. IX. fig. 3); but the secondary process is always a mere rudiment, except, perhaps, in some of the young bristles inferiorly, or in those specially protected (*e. g.* Pl. IX. fig. 4). The general characters of the form agree with *L. rarispina*; but the bristles differ considerably from Malmgren's representations. The young forms do not show the cilia on the ventral cirri—an absence which may have been due occasionally to position; but the want of the characteristic elongated processes on the scales of such is peculiar.

Malmgrenia Whiteavesii *, n. sp.

A single small specimen about ¼ inch long occurred between Anticosti and the Gaspé peninsula in 110 to 221 fathoms. The segments are about twenty in number, and the feet deeply cut; scales absent. The head is apparently eyeless. Antennæ, palpi, and cirri smooth and much tapered. The dorsal cirri do not extend beyond the tips of the bristles; the ventral reach the bases of the latter. The dorsal branch of the foot bears a series of rather slender, elongated, translucent bristles with fine serrations and a characteristic tip (Pl. IX. fig. 5); a few next the body are short and more boldly serrated. The ventral form two sets,—a superior and larger group of delicate elongated bristles with tapering tips, minutely bifid at the extremity (Pl. IX. fig. 6); the tips gradually diminish towards the inferior border of the series, the whole, however, being bifid. At the ventral edge another, small group of stouter bristles exists, the number being variable, generally from six to eight: the enlarged tips of these are serrated for the lower half; then the smooth tip diminishes to a hooked point (Pl. IX. fig. 7).

Antinoë Sarsi, Kinb.

This species is not uncommon in the gulf. The scales have cilia on their posterior and outer borders, and small conical spines. The much elongated and tapered dorsal cirri have rather short clavate papillæ continued almost to the tip of the organ. The ventral cirrus has shorter cilia of a similar shape. The dorsal bristles are distinctly curved, and have somewhat wide and prominent rows of spines, so that in some positions the more slender forms resemble stems of the common *Equisetum*. The superior ventral series of bristles have capil

* The genus is a new one lately formed for certain British species. The specific name is explained in the first paragraph of the paper.

tips of extreme delicacy; a few in the centre of the foot are stouter, while the shorter ventral forms have again a capillary termination. A parasitic *Loxosoma* occurs on the bristles.

Eupolynoë occidentalis, n. sp.

A fragment of the anterior end was procured in 110 fathoms between Cape Rosier and Cape Gaspé, so that only an imperfect description is at present attainable. It is a large form, with comparatively short feet and slender bristles.

The head is dull purplish, two eyes being placed at the posterior and outer part, and two larger in front on the lateral prominence. Tentacle absent; antennæ slender, subulate, and furnished with clavate papillæ. Palpi brownish, with minute though rather elongated papillæ. Tentacular cirri tapered, with numerous large clavate papillæ. A single dorsal cirrus only was found loose on the dorsum; it was filiform, gently tapered from the base to the point at which the more rapid narrowing of the tip occurs. The base is covered with a dense series of long papillæ, which exceed the diameter of the organ; they are shorter towards the tip. The long papillæ are remarkably slender, uniformly cylindrical, with a slightly bulbous tip. The ventral cirrus tapers from base to apex, and is nearly smooth; a few short papillæ, however, are visible in some. The ventral papilla is well marked and nearly cylindrical.

The dorsal bristles are rather small, not much tapered towards the tip, which is somewhat blunt and peculiarly curved (Pl. IX. fig. 8, one of the longer forms). The rows of spikes continue nearly to the tip. One of the stouter forms is given in fig. 9.

The ventral bristles are brownish rather than yellow, and are grouped in three series. The upper are rather slender, have elongated, tapered, spinous tips, which terminate in a slender fork, a modification of the normal structure (Pl. IX. fig. 10). Some have the fork even more slender and elongated than represented in the figure; others, again, have a shorter and stouter fork (Pl. IX. fig. 11). The next series have shorter tips and somewhat stouter shafts, the tips generally being evidently bifid (Plate IX. fig. 12). The latter represents an average example, some having a more elongated, others a shorter and less distinct fork. The inferior series, again (fig. 13), all have stout shafts and simple tips, the curves of these and their general contour showing progressive changes from series to series. This and the next approach the *Lepidasthenia elegans* of Grube from the Mediterranean.

Eupolynoë anticostiensis, n. sp.

Dredged rather abundantly in various parts of the Gulf of St. Lawrence in 1873. Distinguished under the naked eye by the somewhat elongated and flattened cylindrical body, covered with curiously mottled brownish scales with a distinct median spot.

Head with two eyes situated near the posterior border, and two under the outer margin of the somewhat pointed anterior lobes, so that they are not seen from the dorsum. The tentacle has a filiform tip, and the tentacular and dorsal cirri are furnished with rather short but very characteristic clavate papillæ. The palpi likewise terminate in a filiform tip, and have minute papillæ sparsely distributed. The ventral cirri are short, scarcely reaching the base of the bristles, and with a few short clavate papillæ. The tips of the dorsal cirri also scarcely reach the tips of the bristles. The caudal styles are somewhat short.

There are fifteen pairs of scales, covering the body completely from head to tail; they are small in front, and increase in size posteriorly, the last pair being the largest as well as the most ovoid. From the brownish spot in the centre a curved brownish band, minutely speckled, proceeds inwards, sweeps round the posterior border, and terminates at the outer edge. This gives the dorsum of the perfect animal the characteristic appearance formerly noted. They are nearly smooth, with the exception of a few short papillæ on the surface.

The dorsal branch of the foot has finely tapered and boldly serrated bristles, somewhat like those in *Nychia* (Pl. X. fig. 1). Some shorter forms occur next the body (Pl. X. fig. 2). The ventral division has superiorly a group with extremely elongated tips, some of which, however, are minutely forked if careful investigation is made (Pl. X. fig. 3). The tips gradually diminish in length and increase in stoutness, the bifid end having a broad and rather blunt terminal hook and a well-marked secondary process inferiorly (Pl. X. fig. 4).

There are considerable differences between this and the former species; but in the present state of the Annelida complication in names is to be avoided.

Nemidia (?) *canadensis*, n. sp.

Body somewhat elongated, consisting of about forty-eight segments exclusive of head and tail. The head has four eyes, which hold a somewhat median position—that is, leave a considerable space in front and behind the pairs. The anterior pair, as usual, are larger. The palpi are smooth; tentacle and

cirri short, the latter having small and sparsely distributed papillæ. The dorsal cirri do not quite reach the tip of the bristles, while the ventral do not extend beyond the base of the lowest bristles. A conspicuous row of brownish papillæ runs along the centre of the dorsum.

The scales are small, occupying only the lateral region of the body, and leave seventeen segments uncovered posteriorly. Their number seems to be fifteen pairs; but in none were they complete. They are more or less circular throughout, and have only a very few short papillæ on the posterior and outer edge.

The dorsal branch of the foot bears a series of rather short slender translucent bristles, very finely serrated (Pl. X. fig. 5). The superior series of the ventral group have elongated tips terminating in a fine point (Pl. X. fig. 6). The spiniferous rows are elevated on scale-like processes, as in certain forms described in the 'Porcupine' collection, with the free edges finely pectinated. The shaft of these bristles is quite smooth, while the dilated terminal portion is marked by fine longitudinal lines. The foregoing are succeeded by a stouter series with shorter tips (Pl. X. figs. 7 & 8), with only five or six conspicuous rows of spines, while the tip ends in a stout slightly hooked point. The first of the series has a more slender point, and with the others distinguish the species from Malmgren's *N. Torelli*. At the extreme ventral edge, again, a few slender bristles with finely tapered tips occur.

Nemidia (?) *Lawrencii*, n. sp.

In this form the scales are tolerably large and cover the back entirely, except anteriorly in the region of the fourth and fifth pairs. The segments number about 38.

The head is elongated from before backwards, and the pointed anterior lobes diverge in a characteristic manner. The eyes are small—a pair situated near the posterior border, and a larger pair on the lateral region in front of the middle line. Tentacle somewhat slender. Palpi furnished with distinct clavate papillæ. Tentacular and dorsal cirri with short clavate papillæ. The short and tapering dorsal cirri scarcely reach the tip of the bristles. The ventral cirri seem to be smooth.

The scales are somewhat ovoid, and nearly reach the posterior extremity of the animal, which has two long tapering caudal styles. They are almost smooth, a very few minute papillæ only occurring at wide intervals. Their number appears to be about fifteen pairs. Four bristled segments

exist between the posterior border of the last scale and the tail.

The superior branch of the foot has a series of pellucid bristles, somewhat stouter on the whole than in *N. canadensis*, and with bolder characters (Pl. X. fig. 9). They are finely serrated towards the tip, a feature which attains much more development in the shorter and stouter forms than in *N. canadensis*. The superior ventral bristles have long tips with somewhat less prominent rows than in *N. canadensis*; and the end is less capillary, though it is finely pointed (Pl. X. fig. 10). The larger size of the bristles also in the specimens brings out the smooth portion at the tip more distinctly. The tips in the succeeding forms are stout and sharply pointed, and the spined portion shorter and less prominent (Pl. X. fig. 11). The sabre-shaped tips of the latter are prominent features. This and the foregoing agree in certain respects both with *Enipo* and *Nemidia*, Malmgren. In regard to length of body they approach the latter, which, however, he describes as eyeless. The dorsal cirri, again, in *Enipo* are smooth. In British specimens which I have referred to the latter there are a few peculiarly bifid bristles besides the forms mentioned by Malmgren in the ventral group. In the foregoing Canadian examples the tips of all the bristles are simple.

Polynoë gaspéensis, n. sp.

Dredged in 100 to 212 fathoms off Anticosti and in various parts in 1872. A long and highly characteristic form, with fifteen pairs of smooth scales, the first pair only touching each other in the median line, the others being separated by a considerable bare portion of the dorsum; they are translucent, and slightly tinged of a brownish colour in spirit towards the inner border. The first pair are larger, and have their pigment more diffused though not more dense. In shape the first pair are ovoid; and the rest maintain a similar outline, but gradually diminish in size. The fifteen scales occupy thirty-one bristled segments, the last occurring on the thirty-first. In a large specimen there are thirty-seven segments behind the last scale, each bearing a dorsal cirrus as in the case of those in front without scales.

The head is furnished with two eyes placed some distance in front of the posterior border, and two (as usual, somewhat larger and wider apart) at the anterior border. Tentacle long, brownish, the colour being deepest just below the tapering tip, which is pale; a very few slender papillæ occur on this organ. Palpi also brownish, with pale tips, densely covered with short clavate papillæ. Antennæ short, brownish, with pale

tapering tips, sparsely furnished with short clavate papillæ. The tentacular and dorsal cirri have similar clavate processes; and the latter extend rather beyond the extremity of the bristles. The ventral cirri have also a few small clavate papillæ. The papilla at the inner end of the foot is somewhat elongated.

The feet are well marked, though somewhat thick and short. The bristles of the dorsal tuft are short (Pl. IX. figs. 14 & 15). The ventral series consist of one kind, with a stout shaft and a simple tip (Pl. X. figs. 12 & 13). There are comparatively few rows of spikes. The former figure is from the middle of the group, the latter from the superior border. The spine at the base of the smooth tip is well marked in the last mentioned.

The family of the Acœtidæ has no representative; but four examples of the next, the Sigalionidæ, occur. The first is *Sthenelais limicola*, Ehlers, a northern species having a very wide distribution. The second is *Leanira tetragona*, Œrst., which was met with in 1872 off Cape Rosier in 110 fathoms on coarse sand and stones, and in 110 to 221 fathoms between Anticosti and the Gaspé peninsula in 1873. The form is distinguished by its *Sigalion*-like appearance; but the bristles of the feet have simple tapering tips. The antennæ are represented by short processes at the side of the tentacle; and no eyes are visible in spirit-preparations. The scales are pellucid, reniform, and furnished with rather long and nearly cylindrical papillæ, the tips of some of which are obscurely bifid; the rest of the margin is smooth. The superior lobe of the foot bears long bristles with wide rows of spikes, while the basal portion is smooth. A group of long papillæ project from the upper margin of the foot, and occasionally a few are obscurely bifid. Similar organs occur on the inferior lobe. The whole of the bristles of the latter have tapering filiform tips, with apparently a spiral series of markings. The shafts and tips of the superior ventral series are, as usual, stouter than the inferior; but the diminution is not quite uniform, as a strong group occurs just above the most delicate ventral series. The ventral cirrus is well developed, but does not quite reach the tip of the foot. There are three ciliated pads on the dorsal edge below the branchial process. Another *Leanira*, apparently differing from any yet described, though allied to *L. Yhleni*, Mgrn., was procured in 1873 in 210 fathoms off the S.W. point of Anticosti. None of the examples are complete; but it seems to attain a length of 2 or 3 inches.

The head is at once distinguished from *L. lævis* of the 'Por-

cupine' expedition (a species also having smooth scales) by the condition of the median tentacle, which with the other parts conform to the arrangement in *L. tetragona.* The scales are delicate, translucent, irregularly rounded in front, reniform posteriorly, and perfectly smooth round the margin. The dorsal bristles have, perhaps, more closely arranged rows of spikes than in *L. lævis.* The inferior bristles (Pl. X. fig. 14) have delicately tapered tips, with faint spiral indications internally. The latter differ, of course, according to the position in which they are viewed. The ventral cirrus is considerably longer than in *L. tetragona* or *L. lævis*; and the digitate appendages of the lobes of the feet also differ from both. Dr. Malmgren states that his *L. Yhleni* has distinct eyes, and adds that (with the exception of the smooth scales) it agrees with *L. tetragona.* His notice is so very brief that it is impossible to distinguish forms so closely related to each other. The fourth species of the group is the common *Pholoë minuta*, Fabr., which has a wide range.

Several remarks on the Annelida of the neighbouring shores of the United States have been made. Amongst others Dr. Stimpson, in his 'Synopsis of the Fauna of Grand Manan in the Bay of Fundy,' mentions *Euphrosyne borealis*, Œrst., *Cryptonota citrina*, n. sp., *Lepidonota cirrata*, Œrst., *L. punctata*, Œrst., and *L. scabra*, Œrst. The second is probably a *Spinther*; the next two are doubtful; and the third is *Nychia cirrosa*, Pallas. Dr. Leidy *, again, considers *L. punctata* of the former author to be another species, which he terms *L. armadillo*, Bosc; it has dilated cirri, with a black ring, but differs from *L. clava*, Mont., in having cilia on its scales. He also states that *Sigalion mathildæ*, Aud. & Edw., is found on these shores; but the figure of the head given (fig. 53, pl. xi.) shows the prominent median tentacle of a *Sthenelais*; so that some other form is meant. In his recent paper Prof. Verrill indicates "*Hermione hystrix* (?)" as formerly noted, and "*Antinoë Sarsi*," Kbg.

EXPLANATION OF THE PLATES †.

Plate IX.

Fig. 1. Terminal portion of a dorsal bristle of *Lagisca rarispina*, var. *occidentalis.* × 210 diam.

Fig. 2. Superior ventral bristle of the same species. × 90 diam.

* Contrib. &c. Marine Invert. Fauna of Rhode Island, 1855.

† Unfortunately the details in certain of the figures deviate from the originals.

Fig. 3. Inferior ventral bristle. × 90 diam.
Fig. 4. Developing bristle of the same form. × 210 diam.
Fig. 5. Dorsal bristle of *Malmgrenia Whiteavesii*. × 700 diam.
Fig. 6. Superior ventral bristle. × 700 diam.
Fig. 7. Inferior ventral bristle in chloride of calcium. × 700 diam.
Fig. 8. One of the longer dorsal bristles of *Eupolynoe occidentalis*. × 350 diam.
Fig. 9. One of the shorter dorsal bristles. × 350 diam.
Fig. 10. Superior ventral bristle of the same species. × 350 diam.
Fig. 11. Tip of another example. × 700 diam.
Fig. 12. Tip of one of the next series. × 350 diam.
Fig. 13. Tip of one of the inferior ventral bristles. × 350 diam.
Fig. 14. Dorsal bristle of *Polynoe gaspéensis*. × 350 diam.
Fig. 15. Tip of another, showing the blunt termination. × 350 diam.

PLATE X.

Fig. 1. Dorsal bristle of *Eupolynoe anticostiensis*. × 210 diam.
Fig. 2. One of the shorter forms. × 210 diam.
Fig. 3. Superior ventral bristle. × 210 diam.
Fig. 4. Inferior ventral bristle × 210 diam.
Fig. 5. Dorsal bristle of *Nemidia* (?) *canadensis*. × 350 diam.
Fig. 6. Superior ventral bristle. × 350 diam.
Fig. 7. Tip of inferior ventral bristle. × 350 diam.
Fig. 8. One of the same seen from behind. × 350 diam.
Fig. 9. Dorsal bristle of *Nemidia* (?) *Lawrencii*. × 350 diam.
Fig. 10. Superior ventral bristle. × 350 diam.
Fig. 11. One of the lower ventral bristles. × 350 diam.
Fig. 12. Ventral bristle of *Polynoë gaspéensis*. × 350 diam.
Fig. 13. Tip of another, with slightly different characters. × 350 diam.
Fig. 14. Ventral bristle of *Leanira Yhleni* (?). × 350 diam.

XXXV.—*On the Geodephagous Coleoptera of New Zealand.* By H. W. BATES, F.L.S.

[Concluded from p. 246.]

Family **Carabidæ**.

Subfamily *ANISODACTYLINÆ*.

TRIPLOSARUS, nov. gen.

Corpus breviter oblongum, subdepressum. *Caput* pone oculos haud angustatum. *Mandibulæ* edentatæ, basi latæ, apice angustatæ et curvatæ. *Labrum* medio leviter emarginatum, angulis rotundatis. *Mentum* medio dente forti, acuto; lobis extus valde rotundatis, apice intus acutis; epilobiis haud conspicuis. *Ligula* oblonga, apice libera, recte truncata; paraglossis apice æque truncatis, longitudine et latitudine ligulæ æqualibus. *Thorax* transversim quadratus. *Elytra* apice obtuse rotundata, paulo sinuata; striola

scutellaris longa, inter strias primam et secundam posita. *Tibiæ* setosæ; anticæ extus 5-spinosæ.

♂. *Tarsi* quatuor anteriores articulis secundo ad quartum dilatatis, pedum anteriorum brevissimi, intermediorum longiores cordati; articulo quarto nullomodo lobato; palmis ut in *Anisodactylo* dense breviter setosis, planis; articulo primo triangulari, subtus nudo.

This genus differs from the other *Anisodactylinæ* in the form of its head and mandibles, which resemble those of *Phorticosomus*, *Cratacanthus*, &c.; but the eyes are rather prominent; the suture separating the epistome from the forehead is very sharply impressed, and has a short deep frontal foveole near each end. The paraglossæ are lateral, and not placed behind the ligula, as in other genera of the group.

Triplosarus fulvescens, n. sp.

T. ochraceo-fulvus, subnitidus, capite thoraceque interdum æneo tinctus; thorace antice rotundato, postice modice angustato, angulis posticis obtusis, basi utrinque fovea lata, indistincte punctulata; elytris in utroque sexu sericeis; interstitiis planis, tertio postice unipunctato. Long. 4–4½ lin. ♂ ♀.

Harpalus novæ-zelandiæ, Castelnau, Trans. R. Soc. Vict. pt. ii. vol. viii. p. 194?

Castelnau's description applies to the species as far as it goes, except the size (5 lines). My specimens came from Mr. Henry Edwards (from Auckland?) and Mr. Fereday of Christchurch.

Lecanomerus latimanus, n. sp.

L. ovatus, piceo-fuscus, modice nitidus; partibus oris, antennis, pedibus, elytrorumque marginibus (postice dilatatis) fulvo-testaceis; thorace transversim quadrato, vix postice angustato, angulis posticis rotundatis, supra basi lævi haud foveato; elytris ovatis, convexis.

♂. Tarsi quatuor anteriores articulis secundo et tertio magnis, maxime dilatatis; secundo semicirculari; tertio paulo breviore, haud angustiore; primo breviter triangulari; quarto brevissimo, lato, quam tertio paulo angustiore, nullomodo lobato.

Long. 2½ lin. ♂.

The form of this curious insect is that of an *Oöpterus*, the elytra being ovate (much broader than the thorax) and convex; but the broad patelliform anterior and middle tarsi of the male, with their even, smooth brush-soles, show that it belongs to the Australian genus *Lecanomerus* (Chaud.). It agrees in all other generic characters with *L. insidiosus*; but the second tarsal joint is shorter and more semicircular, and the fourth is much broader. The elytra in the unique specimen are dark pitchy brown with fulvous lateral margins, not very well

defined, but widening much at the apex; there is no puncture on the third interstice, and there is a short scutellar striole between the first and second striæ. The margins of the ventral segments are more or less fulvous.

One example, from New Zealand. Obtained from the late Rev. Hamlet Clark's collection.

Hypharpax antarcticus.

Harpalus antarcticus, Castelnau, *l. c.* p. 193.

Christchurch (*Mr. Fereday*).

Scarcely belongs to *Hypharpax*, the hind tibiæ of the male not being arcuated; in facies and in the long fine bristles on the innerside of the tibiæ, with a row of shorter spines on the outer side, it resembles that genus. Four joints of the four anterior tarsi of the male are dilated, and smooth, brush-like, beneath.

Hypharpax australasiæ.

Harpalus australasiæ, Dej. Sp. Gén. iv. p. 386.

Hypharpax australis.

Harpalus australis, Dej. *l. c.* p. 385.

Both these species are found in New Zealand, according to Redtenbacher.

Although only the female in each case was described by Dejean, I think they belong to the genus *Hypharpax*.

Subfamily *Harpalinæ.*

Euthenarus, nov. gen.

Gen. *Tachycello* similis. *Palpi* robusti, glabri; articulo terminali fusiformi, versus apicem attenuato, apice leviter truncato. *Antennæ* robustæ; articulo undecimo multo longiore, crasso. *Mentum* parvum, emarginatione semicirculari, dente mediano prominulo acuto. *Ligula* cornea, oblonga, apice libera bisetosa; paraglossis ipsa duplo latioribus et multo longioribus, apice late rotundatis.

♂. *Tarsi* quatuor anteriores articulis quatuor valde dilatatis: primo triangulari; secundo ad quartum brevissimis et latissimis; quarto bilobo; omnibus laciniis argenteis longissimis vestitis.

The insects on which this distinct new genus is founded resemble the *Bradycelli* and small *Stenolophi* of the northern hemisphere, but are widely different in the clothing of the four dilated palms of the male. This is unlike either the squamæ arranged in pairs of the true Harpalidæ, or the even brush of short vertical hairs of the *Anisodactylinæ*, but con-

sists of a few very long linear hair-scales set obliquely on the broad palms and forming a broad fringe to the feet. The paraglossæ also differ from those of the *Harpali* in being very broad, not tapering to the apex, but broadly rounded. The frontal foveæ of the head form short striæ curving to the inner margin of the eye. The thorax is quadrate. The elytra are obtuse at the apex, with a strong sinuation; the scutellar striole is rudimentary between the first and second striæ; the third interstice has one puncture. The males have a hairy fovea in the middle of the first ventral segment, like the *Tachycelli.*

Euthenarus brevicollis, n. sp.

E. oblongus, fusco-æneus; elytris subcupreis; antennis basi, palpis apice, genibusque piceo-rufis; thorace postice paululum angustato, angulis posticis obtusis fere rotundatis, fovea utrinque lata sparsim punctulata; elytris acute striatis, interstitiis planis. Long. 2¼ lin. ♂ ♀.

Lake Coleridge; under stones in dry lagoon (*C. M. Wakefield, Esq.*).

Immature specimens have testaceous-yellow legs and pale under surface of body; but the dark brassy colour of the head and thorax and cupreous elytra remain in all the numerous individuals sent. The hind angles of the thorax are distinct in some examples and perfectly rounded off in others; the basal foveæ also vary in the amount of punctuation, which is always rather coarse.

Euthenarus puncticollis, n. sp.

E. oblongus, fusco-piceus æneo tinctus vel cupreo-æneus; antennis basi, palpis basi et apice, pedibus (femoribus interdum exceptis) rufo-piceis; thorace longiore, postice subsinuatim paulo angustato, angulis posticis fere rectis, fovea basali grosso punctata; elytris apice fortiter sinuatis, subtruncatis. Long. 2¼ lin. ♂ ♀.

Apparently distinct from *E. brevicollis*, although similar in size and coloration. It is decidedly slenderer, with longer thorax, the posterior narrowing of which is slightly incurved and the hind angles more distinct. The general colour is less metallic; and the side rims of the thorax are pale, which is sometimes the case with *E. brevicollis.* A better distinction is the more transverse and stronger sinuation of the apex of the elytra, the edges external to the sinuation being more flattened out; they are finely and sharply striated in the same manner.

Auckland. Several examples from Mr. Lawson and Mr. H. Edwards.

Subfamily *Trechinæ.*

Oöpterus rotundicollis, White, Voy. Ereb. & Terr., Ins. p. 6.
Bay of Islands.

Oöpterus lævicollis, Bates, Entom. Monthly Mag. vol. viii. 1871, p. 14.
New Zealand; precise locality unknown.

Two other species of this genus are described from the Falkland Islands.

It is very easy to confound this genus with *Tropopterus*, belonging to a quite different subfamily, the resemblance in general form between the two being very great.

Subfamily *Bembidiinæ.*

Tachys antarcticus, n. sp.

T. oblongo-ovatus, convexus, testaceo-rufus, nitidus, palpis pedibusque flavo-testaceis; capite foveis frontalibus magnis, profundis, interspatio elongato, convexo: thorace subcordato, lateribus antice valde rotundatis, post medium sinuatim angustato, angulis posticis productis acutis; supra antice convexo, postice transversim depresso, utrinque foveolato, lævi: elytris ovatis, humeris rotundatis utrinque striis 3 prope suturam, fortiter impressis, subpunctatis; interstitio tertio bipunctato. Long. ⅞ lin.

In form intermediate between *T. hæmorrhoidalis*, Dj., and *T. globulus*, Dj. As convex as the latter, but much more slender, the thorax especially being narrower (much narrower than the elytra), more cordiform, and the elytra more ovate and rounded at the shoulders. The antennæ are wanting in both my specimens.

Auckland? (*H. Edwards, Esq.*).

Bembidium (Peryphus) maorinum, Bates, Entom. Monthly Mag. iv. p. 56 (1867).
Christchurch (*Mr. Fereday*).

Bembidium (Peryphus) charile, Bates, *l. c.* p. 79.
Christchurch (*Mr. Fereday*).

I have not again received either of the above species. They form a distinct section, near *Peryphus*, distinguished by the setiferous punctures of the fifth as well as the third interstice of the elytra. In form they closely resemble the European

B. eques; but the thorax is smaller and still more cordate (similar to that of the *Lopha* section). The frontal furrows are deep, and reach to the level of the hind margin of the eyes. The fovea of the hind angles of the thorax has no carina exterior to it. The anterior tarsi of the male have only the basal joint dilated, parallelogrammical, as in *Peryphus eques.*

Bembidium rotundicolle, n. sp.

B. nilotico similis, cupreo-æneum, nitidum: antennis basi pedibusque piceo-rufis; elytris utrinque versus apicem, ipsoque apice flavo-testaceis; thorace fortiter rotundato, basi angusta, marginibus angustis, postice nullomodo explanatis, angulis posticis vix conspicuis, fovea parva juxta angulum lævi; elytris punctato-striatis, extus et apice minus impressis, interstitiis paulo convexis, tertio bipunctato. Long. 1¼–2 lin. ♂.

♂. Tarsi antici articulis duobus dilatatis, apice obliquis et fortiter intus productis.

Differs from the section to which *B. niloticum* belongs by the very narrow margins to the thorax, not explanated behind, and with obtuse hind angles; the sides of the thorax are very strongly rounded, but the base is much narrower than the apex; the apical angles are not at all conspicuous.

Lake Coleridge; under stones in a dry lagoon (*C. M. Wakefield, Esq.*).

Subfamily *Actenonychinæ*.

Actenonyx bembidioïdes, White, *l. c.* p. 2 (1846).

Sphallax peryphoides, Bates, Ent. Monthly Mag. iv. p. 56 (1867).

Christchurch (*R. W. Fereday, Esq.*).

White's description omits all the essential characters of this curious Carabid, and is so vague that there are no means of identifying it without reference to the type. I have seen a specimen so named in the British Museum, which quite agrees with *Sphallax peryphoïdes.* The extraordinary form of the ligula, and other characters, necessitate the formation of a new subfamily for the insect, which will range near the *Odacanthinæ.*

Subfamily *Scopodinæ*.

Scopodes fossulatus.

Dromius (!) *fossulatus*, Blanch. Voy. Pôle Sud, iv. p. 9, t. iii. f. 16.
Periblepusa elaphroïdes, Redtenb. Reise Novara, Col. p. 21, t. i. f. 9.

Blanchard's description accords exceedingly well with a species apparently common at Auckland, with the exception

that no mention is made of the prominent eyes; this omission, however, is supplied to some extent by his figure.

Auckland. Both from Mr. H. Edwards and Mr. Lawson.

A well-preserved specimen, rather larger than usual, agrees exactly with Redtenbacher's description.

Scopodes elaphroïdes.

Helæotrechus elaphroïdes, White, *l. c.* p. 5, t. i. f. 5.

Larger than the preceding ($2\frac{1}{4}$ lines), and differing besides in being "deep black," *S. fossulatus* being silky æneous; the legs are "yellow, with middle of femora and the tips with a brownish band."

Scopodes aterrimus, n. sp.

S. magis elongatus, gracilior, toto insecto sericeo-niger; thorace angustiore, ab angulo anteriore usque basin recte angustato, supra subtiliter strigoso sed nitido; elytris striis latis paulo undulatis, impunctatis, foveis tribus magnis prope suturam alterisque irregularibus versus apicem. Long. 2-$2\frac{1}{4}$ lin.

Distinguished from *S. fossulatus* and from all the Australian species known to me (nine in number) by the form of the thorax—rather narrow, with slightly prominent antero-lateral angles, and without trace of posterior angle, the lateral margin being rounded off to the base; the surface is rather faintly transversely strigose and shining.

Two examples from Mr. H. Edwards (Auckland), and one from Christchurch (Mr. Fereday).

Subfamily *Coptoderinæ.*

Agonochila binotata.

Lebia binotata, White, *l. c.* p. 2.
Gomelina binotata, Blanch. Voy. Pôle Sud, iv. p. 12 (1853).
Agonochila binotata, Chaud. Bull. Mosc. (1848).
Coptodera (*Agonochila*) *antipodum*, Bates, Ent. Monthly Mag. iv. (1867), p. 78.
Sarothrocrepis binotata, Redtenb. Reise Novara, Coleop. p. 7.

Christchurch.

Subfamily *Calleidinæ.*

Demetrida lineella, White, Zool. Ereb. & Terr., Ins. p. 2, t. i. f. 3.

Port Nicholson.

Demetrida nasuta, White, *l. c.* p. 2.

Auckland (*H. Edwards, Esq.*).

Demetrida picea.

Demetrida picea, Chaud. Bull. Mosc. 1848, i. p. 77; Ann. Soc. Ent. Belg. tome xv. p. 195 (1872).
Cymindis australis, Hombr. & Jacq. Voy. Pôle Sud, Zool. t. i. f. 7 (1842?).
Cymindis Dieffenbachii, White, Dieffenb. New Zeal. vol. ii. p. 273 (1843); Blanch. Voy. Pôle Sud, Zool. iv. (1853).

Christchurch (*Mr. Fereday*).

Chaudoir's name must remain for this species, according to the rule that the first unoccupied name accompanied by a description takes the priority. The figure in the 'Voyage au Pôle Sud' was published eleven years before the description, and was erroneously lettered *C. australis*, not being the *C. australis* of Dejean. Blanchard himself corrected this error in 1853; but long before that date Chaudoir's excellent description had appeared. White's name was simply given (without description) to the above-mentioned figure, in place of the erroneous *C. australis*.

Species of doubtful position.

Pedalopia novæ zelandiæ, Castelnau, *l. c.* p. 154.

XXXVI.—*Remarks on Mr. H. J. Carter's Letter to Prof. King on the Structure of the so-called* Eozoon canadense. By WILLIAM B. CARPENTER, M.D., LL.D., F.R.S., Corresponding Member of the Institute of France.

THE well-merited reputation which Mr. Carter has gained by his researches on *Sponges* and *Foraminifera* will doubtless give to his decided expression of opinion *against* the Foraminiferal character of the (so-called) *Eozoon canadense* a very considerable weight with those naturalists who regard the question as still *sub judice*.

Had Mr. Carter (whose additions to our knowledge of the minute structure of certain types of Foraminifera are estimated by no one more highly than by myself) pronounced this opinion after a careful study of what has been written *in favour* of the Foraminiferal character of *Eozoon*, and after an examination of the *pièces justificatives* therein referred to, I should have respected it, however different from my own, as that of an able investigator who has the fullest right both to form and to publish his judgment, and should not have troubled the scientific public with any further discussion of the question at issue.

But that the readers of Mr. Carter's letter may form a right estimate of the value of his *pronunciamento*, they ought to be aware of the following facts:—

1. Mr. Carter, as I learn from himself, has not read any thing that has been written upon the opposite side of the question.

2. Mr. Carter's ideas of Foraminiferal structure are based, not upon a comprehensive survey of the entire group, but upon that of the small number of types he has himself examined. This is clear from the fact that his definitions (pp. 191, 192) apply only to a certain section of the *Vitreous* or "perforate" Order, and exclude the *Porcellanous* and the *Arenaceous* Orders—the first of them uniformly "imperforate," the second generally so.

3. Mr. Carter's knowledge of *Eozoon* is avowedly confined to that which he has derived from the examination of the specimens sent to him by Prof. King. If he had asked me to show him the chief results I obtained from a study of the large mass of material put into my hands by Sir Wm. Logan, which occupied nearly my whole time (during slow convalescence from a severe illness) for a space of two months, I should have most gladly done so; and I feel sure that I should at any rate have demonstrated to him that there is a great deal more to be said in favour of the Foraminiferal nature of *Eozoon* than he has at present any idea of.

Hence Mr. Carter's affirmation, that the opinion of those from whom he differs on this question has no other basis than "the wildest conjecture," and his imputation to them of incapacity to distinguish things as different from each other "as the legs of a table are from the legs of a quadruped," are to be considered simply as specimens of a new method and language, which, after Prof. Huxley*, I may term *Carterese*. Whether its general adoption will be good for the progress of Science, may be an open question: I will give an example of its application.

Geologists who have worked over the Greensand near Cambridge, have met with spherical bodies varying from the size of a marble to that of a small cricket-ball; which, I learn from Prof. Ramsay, they were accustomed to kick about as inorganic concretions, without the smallest idea of their organic origin. The discovery by Prof. Morris, however, of a non-infiltrated specimen, led me to examine the internal structure of these solid balls; and this examination brought me to the knowledge of the *entirely new* and, in many particulars, *ano-*

* "To call a man an Atheist, in *Recordese*, simply means that you don't agree with him."

malous type of Foraminiferal structure, formed by the cementation of sand-grains in concentric spheres, which I have described under the name *Parkeria* (Phil. Trans. 1869). But as this type does not happen to conform to Mr. Carter's preconception of a Foraminifer, and as he might examine one or more of the silicified balls without finding any indication of organic structure, the principle on which he has acted in regard to *Eozoon* would justify him in asserting that nothing but the "wildest conjecture" could make it out to be Foraminiferal, for that "its structure does not bear so much resemblance to that of a foraminiferous test as the legs of a table to those of a quadruped." Now it so happens that every conclusion I had drawn from the careful study of the *best-preserved* specimens of *Parkeria* has been fully confirmed, and its anomalies explained, by the discovery, in our Deep-sea dredgings, of a *living* Arenaceous Foraminifer (with the animal in it), whose structure conforms, in all essential particulars, to that of *Parkeria*. I may fairly, then, apply Mr. Carter's words to *his own* method, and say that, "if such be the grounds on which geological inferences are established, the sooner they are abandoned the better for geology, the worse for sensationalism."

Those whose knowledge of Foraminifera ranges over the *entire group* as at present known, have the most unlimited belief in its "possibilities;" and it has thus come to pass that they accept the Foraminiferal character of the *Eozoon*, on the basis of the large number of *parallelisms* which its structure presents to that of existing types, notwithstanding some *differences*, which they regard as comparatively non-essential.

To say nothing of my *collaborateurs*, Mr. W. K. Parker, Prof. T. Rupert Jones, and Mr. H. B. Brady, whose opinions may be thought to have been personally influenced by my own, I may cite the judgment recently given by the late Prof. Max Schultze not long before his lamented death, as that of an entirely unprejudiced and fully competent "third party," whose opinion even Mr. Carter is bound to respect, on account not only of his well-known profound mastery of Zoology generally, but of his *special* knowledge of Foraminifera—his admirable Treatise 'Ueber den Organismus der Polythalamien' having been referred to in my 'Introduction to the Study of the Foraminifera' (1862) as "among the most important of recent contributions to our knowledge of the organization and life-history" of the group. In the spring of last year, Prof. Schultze requested me to send him some specimens of *Eozoon*, in order that he might form his own judgment of its nature, at the same time stating the general opinion among German

geologists to be adverse to its organic character. In response, I forwarded to him two specimens—one a transparent section taken from the same block as that which furnished the section examined by Mr. Carter, the other a decalcified slice. Subsequently, at his request, I sent him the largest specimen of *Eozoon* I could spare *en bloc*, that he might make preparations for himself. The result of his examination of these specimens was *to satisfy him completely* of the Foraminiferal character of *Eozoon* *. This conclusion was formed without any "verbal arguments" or "prolonged disputations," but on the basis of Prof. Schultze's own "actual comparison of specimens" of *Eozoon* with specimens of recent Foraminifera—the former showing the very structures which Mr. Carter could *not* find in the specimens he examined, and the latter exhibiting those precise parallelisms which the recent types referred to by Mr. Carter do *not* furnish.

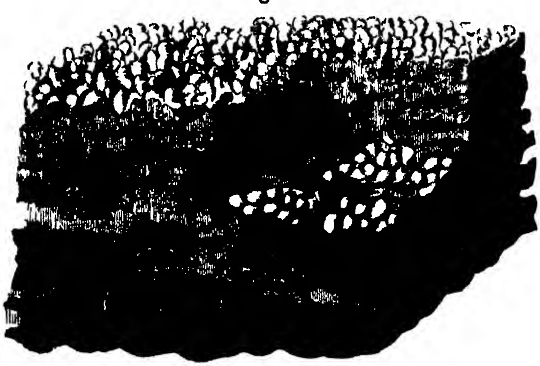
I shall now briefly state what these parallelisms are.

1. Large masses of rock occur in the Laurentians of Canada, in which there is a very regular alternation of lamellæ of Carbonate of Lime (sometimes replaced by Dolomite) with lamellæ of Serpentine or some other Magnesian Silicate, often to the number of fifty or more. For this alternation, such eminent Petrologists as Dr. Sterry Hunt and Mr. Sorby have expressed their inability to account on any known principles of Mineralogical formation; on the other hand, it becomes perfectly intelligible when we view the calcareous lamellæ as having been successively formed by the growth of a Foraminiferal shell, and the serpentinous lamellæ as having been subsequently produced by the replacement of the sarcodic body which occupied its cavities by a deposit of serpentine or some other silicate; for such replacement *is going on at the present time*, so as to furnish us with internal casts of various *Foraminifera* brought up by dredging from the ordinary sea-bottom—these internal casts giving us (when the calcareous shell is dissolved away by dilute acid) the perfect models, not merely of the segments of the sarcodic body, but also of the sarcodic ramifications of the canal-system, and even, in some instances, of the sarcodic threads filling the minute tubuli of the shell-wall. Even so, when the calcareous lamellæ of *Eozoon*

* Referring to the sections I had sent him, Prof. Max Schultze said, in a letter dated Aug. 16, 1873, "Some points are very difficult to settle; but the organic structure cannot be doubtful." And after making his own investigation on the piece I had subsequently sent to him, he said, in a letter dated Nov. 15, 1873, "In the last number of the 'Comptes Rendus' of the Association of Wiesbaden, I gave a short extract of my researches on Eozoon, quite accordant with yours." A translation of this report will be found in p. 324.

have been dissolved away, we have such a Serpentinous fabric as is represented in fig. 1; in which we recognize those general features of conformity to the Foraminiferal type which

Fig. 1.



Structure of *Eozoon canadense.*

were first pointed out by Professor Ehrenberg as exhibited in the Green-sands of various Geological periods, with details which accord most remarkably with those of particular types.

2. Although, in its indefinite zoophytic mode of growth, *Eozoon* differed from the *Nummulites* and *Orbitoides* to which Mr. Carter refers, yet it agrees with *Polytrema**, a type which was formerly described as a Millepore, but which I have shown to be a wildly-growing Rotalian. Further, in its imperfect segmentation, only interrupted occasionally by a complete chamber-partition, it agrees with *Carpenteria*†, another Rotalian; my description of which, as of the preceding, and my references to them in my account of *Eozoon*, it is of course only consistent in Mr. Carter to ignore, on his principle of not reading any thing on the other side.

3. The general plan of the Calcareous fabric, as we should see it if we could dissolve out the Serpentine, is shown in fig. 2, which was constructed from sections in my possession by the conscientious and intelligent draughtsman Mr. George West, to whom I was indebted for those admirable constructive representations of various types of recent *Foraminifera* whose accuracy no one has ever challenged‡. This shows the suc-

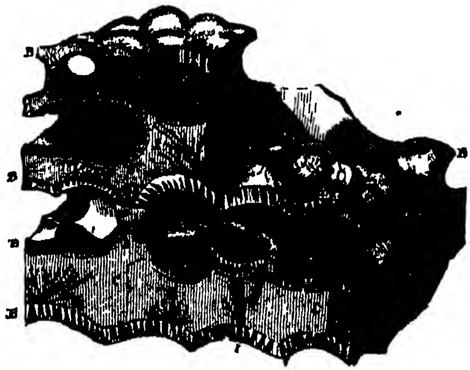
* Introduction to the Study of Foraminifera, p. 235.

† *Op. cit.* p. 186.

‡ A most remarkable proof of this accuracy was afforded by the fact that Mr. G. West's reconstruction of the complicated canal-system of *Polystomella* ('Introduction to the Study of the Foraminifera,' pl. xvi. fig. 1) was made four years before I obtained the internal cast (fig. 9), which verified it to the minutest particular.

cessive stories of chambers (A^1 A^1, A^2 A^2), the chambers of one story usually opening into one another like apartments *en suite*, but being occasionally divided by complete septa traversed by passages, as at *b b*. Each chamber is enclosed in a chamber-wall, B B, which, when well preserved, alike in sections and in internal casts, exhibits a fine nummuline tubulation, generally perpendicular in its direction, but frequently presenting exactly those varieties which I have figured and described in the tubulation of the recent *Operculina*. I freely admit that there are two anomalies in the arrangement of this tubulated chamber-wall:—first, that it covers the floor, resting on the preformed intermediate skeleton, as well as forms the ceiling; and, second, that its tubulation is sometimes horizontal. But looking to the wonderful variability of the Foraminiferal type, and the number of the parallelisms exhibited in the calcareous structure here represented to the known

Fig 2



Structure of *Eozoon canadense*.

forms of Foraminiferal organization, I ask whether, in the face of the continual discovery of far more strange anomalies (as in the case of *Parkeria*), these entitle any one to affirm that this structure is a mere pseudomorph. If the accuracy of that representation is questioned or denied, I have simply to say that I can prove it to any one who will examine the preparations in my possession.

4. The "intermediate skeleton" (fig. 2, C C) precisely corresponds in its disposition, and in the distribution of the canal-system (E) which traverses its thicker layers, with the intermediate skeleton of *Calcarina*, another type fully elucidated by me, to which Mr. Carter makes no reference; and there is this further very curious correspondence—that the

canal-system originates, not directly from the chambers, but, as in *Calcarina*, from a set of sinuses *outside* the tubulated chamber-wall. Now Mr. Carter seems to suppose that Dr. Dawson, and all those who agree with him in this identification (which Dr. Dawson first made by comparison with specimens of *Calcarina* he had received from myself), have been so "green" as never to have thought of the probability that the so-called canal-system may be nothing else than dendrites of glauconite. This hypothesis has from the first been present to our minds, as Mr. Carter would have seen if he had read the memoirs which he has thought fit to ignore. And, not to mention other reasons, I may state two, which perfectly satisfy Mr. Sorby (the most eminent authority on micro-mineralogy) that they cannot be thus accounted for. First, these dendrites usually pass *directly across* the cleavage-planes of the calcareous shell, between which, if they were infiltrations, they would be almost certain to spread. Second (and this is, to my mind, still more conclusive), that minuter part of the canalicular system which is only to be discerned in the very transparent calcite by a careful management of the light (and which Mr. Carter has obviously not recognized), is *not infiltrated with any foreign mineral* at all; but is simply filled up with calcite, disposed in the same crystalline axis with that of the shell itself, as is the case in the consolidated calcareous network of the fossil spines of *Echinida*, the stems of *Crinoidea*, and the like. An experience of thirty-five years, extending over a wide range of Micro-palæontological inquiry, has given me, I venture to think, some special aptitude for recognizing Organic structure when I see it; and I never saw, in any fossil whatever, more distinct evidences of organic structure, than are to be seen in these finer ramifications of the canal-system of *Eozoon*, which are far more distinct than is the tubulation of any but the best-preserved fossil Nummulites.

I do not pretend to affirm that the doctrine of the Foraminiferal nature of *Eozoon* can be *proved* in the demonstrative sense. But I do affirm that the *convergence of a number of separate and independent probabilities*, all accordant with that hypothesis, while a separate explanation must be invented for each of them on any other hypothesis, gives it that *high probability* on which we rest in the ordinary affairs of life, in the verdicts of juries, and in the interpretation of Geological phenomena generally.

To any one who calls in question the evidentiary facts I have adduced, I simply say "Come and see." I cannot be

expected to trust out of my possession valuable preparations, which, if lost or injured, I might never be able to replace. But I am quite willing to give time and trouble to enable those who wish to make the "comparison of the actual specimens" for themselves, to do so, without any "verbal arguments" or "prolonged disputations."

If the so-called *Eozoon* be really an Organic structure, whether Foraminiferal or any thing else, it is time that it should be generally acknowledged as such. But if it can be shown to be a Mineral pseudomorph, I quite agree with Mr. Carter that the sooner it is exploded as a sham, the better it will be for Geology. I trust that my scientific career has given sufficient evidence of my having "loved truth better than system," to justify my assertion that I shall be quite ready to surrender it, if I can be proved to be mistaken (as I have been before now) by the examination of my own specimens, and that I shall even thank any one who will set me right. No one, however, of the many eminent scientific men who *have* examined and compared these specimens, has as yet pointed out to me any error in my interpretation of the appearances they present; and nearly all of them have expressed their unreserved acceptance of it.

XXXVII.—*On the Arrangement of Sponges.* By Dr. J. E. Gray, F.R.S. &c.

I proposed an arrangement of sponges in the 'Proc. Zool. Soc.' 1867, p. 502, of which I suggested a modification in the 'Ann. & Mag. Nat. Hist.' 1868, i. p. 165, and 1872, ix. p. 440, and especially in a paper which I wrote on the division of the spicules of sponges into types (Ann. & Mag. Nat. Hist. 1873, xii. p. 203).

The continued study of the structure of sponges and of their spicules has induced me to propose an alteration in their arrangement, as a sequel to the last quoted paper, which I believe will make it more natural and facilitate their study.

I would divide the Porifera, or sponges, into four orders:—

Order I. Arenospongia (Ann. & Mag. Nat. Hist. 1872, ix. p. 448, enlarged). The sponges strengthened by particles of sand, fragments of spicules, and other siliceous bodies, which they collect from the sea.

Order II. Thalassospongia (Ann. & Mag. Nat. Hist. 1872,

ix. p. 446). The sponge olive, formed of a fleshy or horny skeleton, and strengthened by regular siliceous spicules which are secreted by it; ovisacs membranaceous, scattered in the substance of the sponge.

Order III. POTAMOSPONGIA (Ann. & Mag. Nat. Hist. 1872, ix. p. 461). The sponge green; skeleton strengthened by regular siliceous spicules; ovisacs cartilaginous, strengthened by fusiform or birotate siliceous spicules. (See the divisions proposed in the 'Annals' above quoted, p. 461.)

Order IV. CALCISPONGIA. The sponge strengthened by regular calcareous, generally three-rayed, spicules.

Order I. ARENOSPONGIA.

The sponges of this order, which vary in shape from being discoidal, massive, to dendroidal, are peculiar for collecting together the sand or fragments of spicules, which are abundant at the bottom of the sea, for the purpose of giving strength and consistence to their structure; and these answer the same purpose as the siliceous or calcareous spicules which are secreted by the other marine and freshwater sponges. The quantity of horny matter covering the sand, and the quantity of sand enclosed by it, are very different in the different species of these sponges. It sometimes forms a thick, fibrous, horny skeleton, with only a single layer of sand in the centre of the fibre; and in some species this sand is only found in the thicker part of the horny skeleton. In other species the sponge seems entirely formed of sand merely kept together by a thin coat of horny matter.

In the arrangement I proposed in 1867 I placed the sponges of this group in two families, Dysideidæ and Xenospongiadæ, placing the latter family in a subsection which I called sand sponges (Arenospongiadæ), and the other family with the Ceratospongia. But more mature consideration has induced me to increase the suborder Arenospongia and put them together; for it is a very important element in the œconomy of the animal that one family collects together the ready formed siliceous bodies, and the other secretes the siliceous or calcareous spicula by which the body of the sponge is strengthened.

This order consists of two families:—

1. Xenospongiadæ.

Sponges discoidal, strengthened with irregularly placed sand and fragments of spicules.

2. Dysideidæ.

Sponges massive or dendroidal, formed of fibres constituting a more or less thick coat to the more or less abundant sand or fragments of spicules contained in their centre.

Dysidea and *Halispongia*, Bowerbank, Proc. Zool. Soc. 1872, t. vi.

The Xenospongiadæ are peculiar for having a series of very slender diverging filiform spicules on the circumference, and pencils of similar spicules on the mouth of the oscules on the upper surface of the disk, which appear very different from the spicules of other sponges both in structure and position; and I am not aware that they have been observed in Dysideidæ. Some of the calcareous sponges have the oscule similarly fringed or bearded.

Order II. Thalassospongia.

This is a very large and numerous group of sponges, characterized by their secreting the siliceous spicules by which their body is almost universally strengthened; but the number and form of the spicules very greatly vary in the different kinds. In some, as in the coral-sponges, the body is almost entirely formed of spicules which are united together by a deposit of siliceous matter on their surface, forming the whole into a hard siliceous coralloid body; in others the sponges merely form a horny skeleton, containing one or more series of spicules in its central line. I am inclined to place the genus *Spongia*, which is formed entirely of a horny skeleton without any spicules, as an aberrant or abnormal form of this order, though perhaps we may find, when the habit and structure of these bodies are more known, that some species of true sponges (*Spongia*) are aberrant sand-sponges which do not collect sand, and other species are aberrant spicular sponges that do not secrete spicules.

The Thalassospongia may be divided into various suborders according to the spicules which they secrete, and whether they secrete spicules of all, of one, or of two or more of the types of spicules which I described in the 'Ann. & Mag. Nat. Hist.' 1873, xii. p. 203.

The sponges are all provided with more or less abundant simple subcylindrical spicules, which may be regarded as the basis of their skeleton; but some have spicules of one or more of the other types added to them; and I am inclined to divide them into suborders according to the various types of spicules by which their body is strengthened; and they often have free

spicules scattered in the sarcode, which are generally of a small size and uniform shape, and are characteristic of each suborder. Thus they are hamate unilateral in the Hamispongia, sexradiate in the Sexradiatospongia, and stellate multiradiate, in the form of spicular spherules, in the Quinqueradiate group.

In the division of the marine sponges, like other natural bodies, into suborders or types the characters of the orders given are those of the general mass of species belonging to it; but there occur genera or families that have most of the characters of the suborder or family but want the essential character of the group—as the genus *Spongia*, which belongs to the order Thalassospongia, but wants the characteristic siliceous spicules. In the same manner *Placospongia* has the spherical spicules of the quinqueradiate sponges, but appears to be without the quinqueradiate spicules; and the Chondrilladæ have the many-rayed spicules of the same suborder, but also want the five-rayed spicules—these groups being what Mr. MacLeay called "aberrant types."

Suborder I. Leiospongia.

The sponges only strengthened by simple, elongate, subcylindrical, fusiform spicules, tapering at each end, or enlarged, club-shaped, or capitate at one or both ends. This suborder is without spicules of the sexradiate or quinqueradiate types, or the free spicules peculiar to each.

This suborder contains many species, and requires much study to make out its structure, which I am glad to say Mr. Carter is bestowing upon it.

It contains:—

1. The *Suberispongia*, which are massive, with inosculating areolar cavities terminating in a vent on the surface—as *Suberitidæ* and *Raphiophoridæ* ('Annals,' *l. c.* p. 447).
2. The *Keratospongia*, with a skeleton formed of reticulated horny fibres having one or more series of spicules in the central line—as *Chalinidæ*, *Phakelliadæ*, *Halichondriadæ*, and *Polymastidæ*.
3. The *Ophistospongia*, with a skeleton like the Keratospongia, but with diverging spicules on its outer surface—as ('Annals,' *l. c.* p. 447).

Suborder II. Hamispongia (Ann. & Mag. Nat. Hist. 1872, ix. p. 448).

Sponges with unilateral spicules, which are curved at each end, and either subcylindrical or more or less expanded, in

addition to the fusiform, clavate, or capitate spicules of the former suborder.

This suborder consists of the family Esperiadæ (Proc. Zool. Soc. 1867, pp. 502, 532), except the genus *Carteria*, which proves to be a sexradiate sponge. Some genera have only the bihamate spicules; but in general they have bihamate and contorted spicules.

In the 'Ann. & Mag. Nat. Hist.' (*l. c.*) I divided this suborder into four families—Esperiadæ, Desmacidonidæ, Hamacanthidæ, and Gelliadæ.

Suborder III. SEXRADIATOSPONGIA.

Sponges with spicules of the sexradiate type, in combination with the simple spicules of the Leiospongia.

This suborder agrees with the Hexactinellidæ of Mr. Carter, so well described in the 'Ann. & Mag. Nat. Hist.' 1873, xii. p. 357, excluding the genus *Hyalonema*, and adding to it the genus *Carteria*, which Mr. Carter partly describes and figures under the name of *Hyalonema*.

In the paper in the 'Proc. Zool. Soc.' for 1867 I formed the order Coralliospongia, and in the 'Ann. & Mag. Nat. Hist.' 1872, ix. p. 447, I considered "the hexaradiate spicules the essential character of the order" (see p. 449). It has since been found to contain a series of sponges which belong to the quinqueradiate type and are placed separate by Mr. Carter, a correction which I gladly acknowledge and adopt.

The radiating spicules which form the skeleton of the body are frequently of large size, and are modified in form according to the position which they occupy in the body. The lateral rays in perfectly developed spicules are generally equal; but at other times one or more of the rays are only partially developed. The shaft or central axis is frequently elongate, much longer than the lateral rays; but when the spicules are on the surface of the sponge the outer end of the shaft is more or less imperfectly developed, sometimes reduced to a single tubercle, and the other end of the shaft on the inside of the sponge is frequently much lengthened. The two ends of the shaft are almost always simple; but the lateral rays, especially of the quinqueradiate type, are frequently forked.

The sexradiate spicules which are scattered in the sarcode, and consequently free from each other, are always of a much smaller size than the skeleton-spicules, and of uniform structure, and nearly all of the same size. Mr. Carter has named them *rosettes*. They differ in the form of their six rays—which are always equal, sometimes simple, ending in a

crenated disk, and at others are simple, subulate, with a more or less spinulose surface, or each divided at the end into two, three, or more linear branches, which are frequently dilated at the end.

In the paper in the 'Annals' above referred to I divided the sponges of this suborder according to their external form; but in the 'Ann. & Mag. Nat. Hist.' 1872, x. p. 134, I proposed to divide them into two groups according to the form of the free spicules; and since then Mr. Carter has shown the importance of the study of the minute free spicules, or *rosettes*.

They may be divided into three sections, as proposed in the 'Annals,' 1872, x. p. 134:—

1. The *rosettes* with the ends of the six rays divided into two, three, four, five, or many branches. Including *Farreadæ*, *Dactylocalycidæ*, *Aphrocallistidæ*, *Euplectelladæ*, *Corbitelladæ*, *Askonematidæ*, and *Crateromorphadæ* (Ann. & Mag. Nat. Hist. 1872, x. p. 134), and *Rossella*, Carter.
2. The *rosettes* with six rays ending in a radiating circular disk. *Carteriadæ*, *Pteronemadæ*, and *Meyerinadæ* (Ann. & Mag. Nat. Hist. 1872, x. p. 134).
   Mr. Carter figures many of the rosettes of these genera (Ann. & Mag. Nat. Hist. 1873, xii. t. 13 & 15).
3. The *rosettes* subcubical, the rays with three lobes at the end. *Axidæ*.

I gave the name of *Axos Clifloni* to Bowerbank's figure (B. S. fig. 197) of the spicule of this sponge; and when Mr. Clifton gave me a fragment of the sponge I described it (Ann. & Mag. Nat. Hist. 1870, vi. p. 272) under the name of *Echinospongia australis*; but at p. 346 of the same volume I showed that *Axos Clifloni* should be adopted. Dr. Bowerbank has since figured the specimen from which the fragment was taken by Mr. Clifton under the name of *Dictyocylindrus dentatus* (Proc. Zool. Soc. 1873, p. 321, t. xxix.), without referring to his figure in his work on British sponges.

Suborder III. QUINQUERADIATOSPONGIA.

Sponges with spicules of the quinqueradiate type in combination with the simple spicules of Leiospongia, and frequently having multiradiate spicules and spicular spherules in combination with them, either scattered free in the flesh of the sponge or forming an external bark to it.

The sponges of this suborder present very numerous combinations of spicules; and the five-rayed spicules which form the skeleton of the sponge frequently want the outer end of

the shaft, and the lower end is generally much elongated; and for this reason they have been called four-rayed, trifurcate, or nail-like spicules. They frequently have free, but more or less abundant, regular-shaped many-rayed spicules, or spicular spherules, scattered in their flesh, which are always of a small size, and more or less regular in their shape.

This order consists of the Sphærospongia and the family MacAndrewiadæ of the 'Annals,' 1872, ix. p. 456.

Section I. Five-rayed or skeleton-spicules often united by siliceous matter; flesh-spicules fusiform, cylindrical, more or less spinose. *Lithistidæ*, Carter (Ann. & Mag. Nat. Hist. 1873, xii. p. 437); *MacAndrewiadæ*, Gray (Ann. & Mag. Nat. Hist. 1872, ix. p. 456.

The sponge formed of superficial sexradiate spicules, which are held together by an amorphous siliceous coat.

Mr. Carter gives an arrangement of the species of the various genera of this group, to which the genera *MacAndrewia* and *Theonella*, Gray, *Corallistes* and *Leiodermatium* of Schmidt, and *Azorica* and *Lithospongitis*, Carter, are referable. In the 'Annals' I placed MacAndrewiadæ with the Coralloid sponges having sexradiate spicules; but the examination of more spicules has proved that they belong to the quinqueradiate type, with the habit of the coral-sponges.

Section II. The skeleton-spicules elongate, free from one another, generally forming the circumference of the sponge, sometimes projecting beyond it.

a. The free flesh-spicules many-rayed, stellate, on the outer surface or inner part of the sarcode. *Tethyadæ*, *Donatiadæ*, *Theneadæ*, *Lophurelladæ*, *Casuladæ*. (See *Ecionemia acervus*, and *E. densa*, Bowerbank, Proc. Zool. Soc. 1873, t. xxx. figs. 1–14.)

b. With spicular spherules forming the outer surface of the sponge. *Geodiadæ*.

c. The spicular spherules crowded together, and forming the axis and plates on the outer surface of the coral-like sponge, with the sarcode and spicules between the two. *Placospongiadæ*.

d. Without any many-rayed stellate spicules or spicular spherules. *Ancorinadæ*.

e. Aberrant family, *Chondrilladæ*, with many-rayed stellate flesh-spicules, but without any elongate five-rayed spicules. See *Chondrilla australiensis*, Ann. & Mag. Nat. Hist. 1873, xii. pl. 1. figs. 14–16.

XXXVIII.—*On a new Species of* Arcturus (A. damnoniensis). By the Rev. THOMAS R. R. STEBBING, M.A.

[Plate XV.]

ARCTURUS DAMNONIENSIS has three conical tubercles on the head—one medio-frontal, with the other two side by side behind it. Each of the body-segments has a similar elevation—that on the elongated fourth segment, not quite so far back as the centre of its dorsal surface, being the most considerable and conspicuous. To this almost central tubercle the dorsal surface of the segment slopes rather steeply up and then rather steeply down to a second tubercle, truncated at the top and standing over the posterior margin. The tubercles of the other segments are less important in size and more sharply pointed than those of the head and the fourth body-segment, that on the second segment being the most diminutive.

Of the pleon or tail three segments are clearly defined:—the first very short; the second less so, and dorsally raised above both the first and the last, the long terminal piece having also a small dorsal elevation in close proximity to that of the second segment. The terminal piece has also at the base a lobe on each side running out into a sharp angle. Further back the lateral margin is again produced into a similar angle; between this and the rather obtuse apex there is a slight indentation in the margin on either side, the two being connected by a small dorsal furrow.

The upper antennæ are about as long as the head; they have a large basal joint, followed by three slender almost transparent articulations and a short seta, the last articulation being longer than the two which precede it both together.

The lower antennæ are as long as the body; four joints are visible and a stiff little-divided flagellum. The first of the four joints is short and thick with a deep external notch; the second is long, clubbed at the distal end; the third is longer again; the fourth is about the same length as the second, but slender and uniform in thickness. All the joints have short outstanding hairs or bristles. The third joint is longer in the male than the female, and in each about corresponds in length with the fourth body-segment.

The female is altogether more strongly tuberculated than the male; and the lateral dilatations over the insertions of the legs are also more pronounced in the female than in the male. The most striking difference, however, between the two sexes is in the fourth body-segment; for this segment in the female, besides carrying the brood-pouch, is dilated at its origin into a large triangular lobe on either side, while in the male there

is a decided contraction of the body in the front part of the fourth segment. This difference is very noticeable when the two specimens are viewed from above instead of in profile.

The total length of each specimen is about half an inch.

The male it fell to my lot to discover in January of this present year, 1874. It was clinging to a small stalk of sea-weed which had been dredged up in the neighbourhood of Babbacombe beach. The following day the meshes of the dredge, which had been plied off Hope's Nose, at a distance of a mile or more from the site of our previous search, yielded the female. This time Mr. W. Wilson Saunders, my companion on both occasions, was the successful discoverer. The dredging off Babbacombe had given us nothing of interest besides the *Arcturus* and *Crangon trispinosus*; that off Hope's Nose, in water of more than 10 fathoms depth, supplied many scores of specimens of *Antedon rosaceus* (*Comatula*), the feather-star, besides several crustaceans of more or less rarity, both stalk-eyed and sessile-eyed—including of the former *Eurynome aspera* and Pennant's *Ebalia*, and of the latter *Ampelisca Gaimardii*, *Cerapus abditus*, *Anthura gracilis*, *Anceus maxillaris*, and *Idotea linearis*.

EXPLANATION OF PLATE XV.

Fig. 1. *Arcturus damnoniensis*, male, enlarged.
Fig. 1 A. The same, seen from above, the tail curved over the body and showing the underside.
Fig. 2. *Arcturus damnoniensis*, female, enlarged.
Fig. 2 A. The same, seen from above, the tail and part of the body foreshortened.

XXXIX.—*Annulata nova vel minus cognita in Expeditione 'Porcupine' capta.* Recensuit E. Ehlers, M.D.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

You would greatly oblige me by giving, as soon as possible, a place in your most valuable Journal to the enclosed paper, containing the diagnoses of new or little-known annelids collected in the 'Porcupine' expedition, and lately examined by me.

I am, Gentlemen,
Yours truly,
E. Ehlers, M.D., P.P.O.

Erlangen, March 11, 1874.

Leanira hystricis, n. sp.

Corpus lineare depressum post paulo attenuatum; segmentis 50–60.

Lobus cephalicus latior quam longior, rotundatus, cæcus, tentaculo lobo duplo longiore in articulo basali e sulco parvo fere centrali lobi cephalici oriente, apicem versus subarticulato gracillimo; palpis longissimis usque ad segmentum octavum decimum protentis, validis, glabris. Cirri tentaculares in pinna setigera simplici magna sub margine anteriore lobi cephalici antrorsum vergentes utrinque tres: in apice pinnæ externus in articulo basali simplex pinna ter longior, internus pinnæ longitudine fere æqualis subulatus; in parte pinnæ interna singulus subarticulatus pinna paullo longior. Laminæ buccales cirris tentacularibus minoribus longiores. Segmentorum pinnæ dimidiam corporis latitudinem æquantes, anticæ mediæque ab latere, posticæ antrorsum vergentes, ramis fere æqualibus parum sejunctis: superiore simplici papilla terminali setis capillaribus simplicibus et serrulatis, inferiore crassiore bilabiato papillas 2 terminales setasque compositas gerente; cirro ventrali ramo inferiore, excepto primo, breviore apicem versus subarticulato; elytris dorsum haud perfecte tegentibus lævibus orbicularibus in segmentorum 1., 3., 4., 6. . . . 25., 26. elytrophoro a ramo superiore pinnæ longe remoto dorsali; branchiis a segmento 26. conspicue obviis postico versus accrescentibus uncinatis deorsum ex elytrophori margine vergentibus. Longitudo 19 m.m.; latitudo cum pinnis 2 m.m.

Hab. (1) 56° 9′ lat. bor., 14° 10′ long. occid., fundo 664 orgyiarum; (2) 59° 35′ lat. bor., 9° 11′ long. occid., fundo 767 orgyiarum; (3) 51° 22′ lat. bor., 12° 26′ long. occid., fundo 808 orgyiarum; (4) 55° 11′ lat. bor., 11° 31′ long. occid., fundo 1443 orgyiarum.

Nephthys pansa, n. sp.

Corpus longum, crassum, lateribus in parte postica profunde incisis. Lobus cephalicus latior quam longior, tentaculis anticis 4 minutis. Rami pinnarum spatio ipsis multo majore distantes, labiis posticis minutis, anticis obsoletis; branchia in laminam magnam undulatam utrinque dilatata; cirro dorsuali ventralique parvo crasso, setis anterioribus brevibus crenatis, posterioribus numerosis longissimis flexuosis subtilissime denticulatis. Proboscis exserta magna crassa, antice labiorum papillis bifidis coronata et ordinibus 22 longitudinalibus papillarum 3–4 antrorsum accrescentium triangularium foliacearum cincta.

Hab. 51° 1′ lat. bor., 11° 21′ long. occid., fundo 126 orgyiarum.

Nephthys Johnstoni (m.).

Corpus procerum et in lateribus partis posticæ sensim attenuatæ profundius incisum, segmentis 120. Lobus cephalicus longior quam latior; tentacula postica majora quam antica. Rami pinnarum, in parte postica corporis elongatarum, spatio ipsis minore sejuncti:

superior labio anteriore humili, labio posteriore in laminam superiorem majorem rotundatam minoremque inferiorem diviso; branchia magna curvata, cirro dorsuali mediocri; inferior labio anteriore obsoleto, posteriore ipso ramo majore ovato-elongato protento, cirro ventrali brevi conico; uterque setis anterioribus brevibus crenatis, posterioribus numerosis longissimis flexuosis in parte media dilatata denticulatis. Proboscis antice labiorum papillis bifidis coronata, ordinibus 22 longitudinalibus papillarum 5–6 filiformium antrorsum valde elongatarum cincta. Longit. 70 m.m.; latit. 4·5 m.m.

Hab. prope Belfast, fundo 75 orgyiarum.

Verisimiliter eadem species, quæ a cel. Johnston ('Catalogue of the British non-parasitical Worms,' p. 172) nomine *N. longisetosæ* descripta est.

Eulalia imbricata, n. sp.

Corpus lineare depressum in postica parte magis quam in antica attenuatum, pallidum, segmentis 70. Lobus cephalicus subovatus, postice productus, cæcus; tentacula 5, anteriora utrinque 2 fere æqualia subulata, posticum singulum verticale minimum. Cirri tentaculares utrinque 4 elongati; prior segmenti primi, secundus et tertius cum pinna parva setigera segmenti secundi; quartus cum pinna setigera cirroque ventrali segmenti tertii. Pinnæ simplices longæ setarum compositarum articulo longissimo terminali cuspidato fasciculo flabelliformi; cirri dorsuales foliacei, parte antica et postica corporis excepta, dorsum imbricatim tegentes brevi-ovati; cirri ventrales foliacei ovato-lanceolati, pinnam fere æquantes; cirri anales 2 crassi cylindrato-ovati. Long. 13·5 m.m.; latitudo cum pinnis c. 2 m.m.

Hab. 56° 9′ lat. bor., 14° 10′ long. occid., fundo 664 orgyiarum.

Eteone cæca, n. sp.

Lobus cephalicus conicus in basi subannulata parum latior quam longior, margine antico indistincte crenato, subpellucido; tentacula infera subæqualia lobo cephalico dimidium fere latitudinis breviora. Cirri tentaculares in segmento primo utrinque 2, inferior superiore paullum longior latitudinem segmenti non æquans; in segmento secundo utrinque singulus subulatus, anterioribus dimidium brevior. Segmentorum ceterorum pinnæ simplices breves, setis cuspidatis; cirri dorsuales a pinna remoti crassi foliacei rotundato-ovati, imbricatim pinnas tegentes; cirri ventrales foliacei semilunares sursum erecti. Proboscis vagina in parte aborali papillas paucas seriatim ferente obducta. Long. 11 m.m.; latitud. cum pinnis 2 m.m.

Hab. prope Galway, fundo 15–20 orgyiarum.

Syllis brevicollis, n. sp.

Corpus lineare antice et postice paullum angustius, dorso convexo ventre plano, segmentis c. 70. Lobus cephalicus latior quam longior, antice attenuatus, fere sexangularis; oculi utrinque 2 appropinquati, anteriores majores magisque distantes quam posteriores; tentacula 3 longa moniliformia, quorum medium articulis 44 duplo longius lateralibus; palpi separati validi lobo cephalico longiores. Cirri tentaculares utrinque 2 moniliformes tentaculis breviores; superior longior quam inferior. Pinnæ sat magnæ setis compositis articulo terminali parum elongato lineari apice bidentato; cirris dorsualibus longissimis moniliformibus articulis 40–50; cirris ventralibus conicis pinna vix longioribus vel æquantibus. Proboscis dente brevi crasso armata in segmentis 12 anticis, ventriculus in sequentibus 8. Color in spiritu fulvidus. Longitudo 18 m.m.; latitudo 1·5 m.m.

Hab. 59° 34′ lat. bor., 7° 18′ long. occid., fundo 650 orgyiarum.

Syllis abyssicola, n. sp.

Corpus lineare dorso convexo. Lobus cephalicus triangularis latior quam longior, cæcus; tentacula moniliformia, medium articulis 17 parum longius quam lateralia 14-articulata; palpi distantes validi lobo cephalico longiores. Segmentum I. in dorso vix conspicuum cirris tentacularibus, tentaculis brevioribus ceterum similibus. Pinnæ magnæ setis compositis, quarum superiores articulo terminali valde elongato lineari, inferiores articulo breviore, nusquam apice bidentato. Cirrus dorsualis moniliformis dimidiam segmenti latitudinem parum superans articulis 9–11; cirrus ventralis anguste lanceolatus pinnam valde superans. Proboscis in segmentis 9 papillis 10 cincta, dente conico obtuso; ventriculus in segmentis sequentibus 7.

Hab. 56° 14′ lat. bor., 11° 37′ long. occid., fundo 1380 orgyiarum.

Diopatra brevibranchiata, n. sp.

Corpus in parte antica subteres, in postica parte depressum. Lobus cephalicus cæcus; tentaculis 5 in articulo basali annulato brevibus subulatis, 2 marginalibus subglobosis; palpis parum prominulis. Segmentum I. breve cirris tentacularibus pedunculatis. Pinnæ segmentorum 3 sequentium maximæ adpressæ complanatæ antrorsum vergentes cirris tentaculiformibus labiisque incisis; ceteræ humiles labiis cirrisque ventralibus evanescentibus, cirro dorsuali in anterioribus subfoliaceo in posticis subulato, in media corporis parte branchiferæ; branchiæ cirris longiores pectiniformes parum dentatæ; setæ pinnarum anteriorum et simplices limbatæ et compositæ cultriformes, posteriorum capillares simplices et teneræ scalpratæ pectinatæ; aciculæ hamatæ.

Hab. 48° 50′ lat. bor., 11° 7′ long. occid., fundo 725 orgyiarum.

Diopatra socialis, n. sp.

Corpus in parte antica subteres, in postica valde depressum; segmentis 110, posterioribus brevibus. Lobus cephalicus cæcus, tentaculis 5 in articulo basali annulato longissimis lævibus filiformibus; marginalibus anticis obtusis, palpis valde prominentibus clavatis. Segmentum buccale magnum, cirris tentacularibus gracilibus filiformibus. Pinnæ segmentorum anteriorum magnæ, labio et cirris gracilibus elongatis; posteriorum sensim decrescentes, labiis cirrisque ventralibus evanescentibus; branchiæ valde diversæ, in omnibus pinnis filiformes simplices, vel in posterioribus solum et filiformes et parum dentatæ vel omnino nullæ. Setæ pinnarum anteriorum compositæ, posteriorum simplices limbatæ et scalpratæ subtiliter dentatæ; aciculæ bidentatæ. Longit. 55 m.m.; latit. 2 m.m. Tubus longissimus limo obductus.

Hab. (1) 51° 1′ lat. bor., 11° 21′ long. occid., fundo 426 orgyiarum; (2) 49° 1′ lat. bor., 11° 56′ long. occid., fundo 557 orgyiarum; (3) 59° 34′ lat. bor., 70° 18′ long. occid., fundo 650 orgyiarum; (4) 48° 50′ lat. bor., 11° 7′ long. occid., fundo 725 orgyiarum; (5) 51° 22′ lat. bor., 12° 26′ long. occid., fundo 808 orgyiarum.

Aricia Kupfferi, n. sp.

Corpus antice acuminatum, postice sensim attenuatum, dorso fere plano in segmentis anterioribus nigro maculato. Lobus cephalicus conicus, nudus, segmentum I. nudum. Pinnæ segmentorum sequentium 14, in ramo superiore cirro filiformi, setis tenuissimis linearibus subtilissime crenatis et simplicibus apice dilatato bifurcato, in ramo inferiore labio postico majore semilunari crenulato, setis seriatim collocatis simplicibus subtiliter crenulatis, paucis validioribus; pinnæ posterioris partis corporis in ramo superiore cirro filiformi, setis longissimis sub apicem fortiter crenatis, ramo inferiore foliaceo-lanceolato elongato apice bipartito, setis eadem, quæ est in ramo superiore, forma; cirro ventrali parvo conico, postice prorsus evanescente; branchiæ a segmento V. incipientes foliaceo-lanceolatæ in dorso a linea mediana remotæ.

Hab. (1) 48° 50′ lat. bor., 11° 7′ long. occid., fundo 725 orgyiarum; (2) 54° 54′ lat. bor., 10° 59′ long. occid., fundo 1366 orgyiarum.

Verisimiliter eadem est species, quæ a cel. Kupffer in libro adscripto 'Bericht über die Expedition zur physikalisch-chemischen und biologischen Untersuchung der Ostsee,' p. 151, est commemorata.

Heterospio longissima, n. gen. et sp.

Corpus animalis e 2 partibus valde diversis constans, quarum anterior depressa 7 segmentis brevibus branchiferis, posterior teres

segmentis paucis perlongissimis nudis constituta. Lobus cephalicus conicus cæcus nudus (?); setæ in segmentis omnibus, segmento buccali excepto, in 2 fasciculis collocatæ longæ sericeæ capillares arcte limbatæ; branchiæ segmentorum anteriorum in articulo basali longissimæ. Long. animalis, cujus pars postrema corporis deest, 25 m.m.; longitudo anterioris partis 7 segmentis constitutæ 2 m.m.; sequentium 4 segmentorum longissimorum 23 m.m.; latitudo 0·8 m.m.

Hab. 51° 1′ lat. bor., 11° 21′ long. occid., fundo 426 orgyiarum.

Praxilla nigrita, n. sp.

Lobus cephalicus brevis conico-acuminatus, non limbatus, cum segmento buccali nudo connatus; segmenta anteriora breviora quam posteriora valde elongata quinquies longiora quam lata, in parte brevi setigera annulata; setæ superiores simplices limbatæ, in segmentis posticis apice subito acuminatæ; setæ inferiores in segmentis setigeris anticis 4 seta unica conica valida, in ceteris uncini apice 4 dentati. Longit. 17 m.m.; latit. 0·5 m.m.; segmenta postica desunt. Color in spiritu fulvidus, in parte segmentorum incrassata nigritus. Tubus crassus limo et arenulis confectus.

Hab. 59° 34′ lat. bor., 7° 18′ long. occid., fundo 650 orgyiarum.

Sabellides fulva, n. sp.

Corpus in parte anteriore inflatum, in postica valde attenuatum, segmentis setigeris 45. Lobus cephalicus cum parte tentaculifera sub labio dorsali segmentorum priorum conditus; tentacula numerosa versus apicem incrassata lævia; palmulæ nullæ: Branchiæ in articulo basali filiformes subulatæ, latitudinem corporis plus duplo superantes, utrinque 3 in dorso segmenti tertii et quarti ordinem transversum medio interruptum formantes. Tubercula setigera subconica in segmentis 15 obvia a segmento quarto incipientia; setæ capillares limbatæ. Uncinorum ventralium ordinum in segmentis 35 obviorum prior sub pinna setigera quarta in toro parum elevato, dein a pinna undecima in pinnulis longis segmentorum omnium sequentium; uncini 5-dentati. Cirri anales nulli. Longit. animalis 42 m.m.; latit. max. 2 m.m.

Hab. 49° 1′ lat. bor., 11° 56′ long. occid., fundo 557 orgyiarum.

Grymæa brachiata, n. sp.

Corpus cylindratum in parte postica parum depressum; lobus cephalicus brevis; tentacula ?; branchiæ simplices subulatæ in segmento primo setigero utrinque 4 seriem transversam formantes, in secundo et tertio utrinque 2. Scuta ventralia simplicia latis-

sima in segmentis I.–XI., in prioribus usque ad dorsum protenta. Pinnæ fasciculos setarum capillarium gerentes a segmento secundo per totum corpus obviæ, in segmentis anterioribus compressæ in dorso collocatæ supino vergentes, deinde subconicæ in lateribus segmentorum collocatæ postico versus spectantes; setæ longæ, sericeæ, limbatæ; uncinorum ventralium ordo prior sub pinna setigera quinta, in segmentis sequentibus in pinnula parva adpressa; uncini minutissimi 3-dentati unisceriales.

Hab. 59° 34′ lat. bor., 7° 18′ long. occid., fundo 650 orgyiarum.

Erlangæ, d. II. m. Martii MDCCCLXXIV.

XL.—*Descriptions of new Species of* Scincidæ *in the Collection of the British Museum.* By A. W. E. O'SHAUGHNESSY, Assistant in the Zoological Department.

Mocoa lichenigera, n. sp.

Body cylindrical; lower eyelid with transparent disk; scales smooth, small, in 41 longitudinal series, those of the inferior surface being exceedingly numerous, considerably over 80 in a longitudinal series, the scales between the chest and chin being smaller than those on the belly; nasals and fronto-nasals not contiguous; internasal almost circular; frontal widened anteriorly and tapering posteriorly; fronto-parietals separate; supralabials six, subequal; ear-opening moderate.

Somewhat resembling *Mocoa Smithii*.

Colour: above olive or bronzed greenish brown, dotted with dark brown; sides with dark brown variegations, forming a wavy line along the margin of the back on each side, and extending on to the tail; lower surface pale yellowish.

Tail rather broad; scales small, uniform; limbs moderate, fore and hind ones meeting in the middle of the side.

Lord Howe's Island. In the collection of the British Museum. Collected by Mr. M'Gillivray.

Mocoa pretiosa, n. sp.

Resembles *M. Entrecasteauxii*, but differs in the much greater number of scales; in the latter there are 56–59 in a longitudinal ventral series, while in the present there are not less than 80. Fronto-parietals united; scales striated or minutely ridged. Colour: bright brown, with median black

stripe and numerous small yellowish ocelli; sides deep brown, with a bright yellowish wavy streak above and below.

The British Museum has received this species from Tasmania. Collected by R. Gunn, Esq.

Mocoa mustelina, n. sp.

Elongate and slender in form; head small; limbs short and wéak. Superficial resemblance to *Hinulia ornata* in coloration; but, besides being distinctly a *Mocoa*, it has much larger and fewer scales: there are 22–24 longitudinal rows as counted round the body, and 52 in a longitudinal ventral series; while in *Hinulia ornata* these numbers are respectively 30 and 62. Colour: bright yellowish brown above, with small mottlings and wavy lines and variegations along the sides, extending in regular streaks on the tail; lower surface pure white; chin dotted with brown; a pure white oblong spot immediately behind the eye.

The British Museum possesses three specimens from New South Wales.

Mocoa microlepidota, n. sp.

Body somewhat depressed. Scales small, those on the back distinctly three-ridged. Lower eyelid transparent. Nasals and fronto-nasals not contiguous; internasal broad, saddle-shaped; fronto-parietal single; no supranasals; 38 longitudinal series of scales as counted round the body, 83 in a longitudinal ventral series. Dorsal surface closely speckled with black and olive, a marginal olive stripe along upper edge of sides; sides with a deep band of dark brown, speckled and breaking into the æneous bluish green of the lower surface, which is also very minutely speckled with brown on the chin. Tail with small uniform scales; when reproduced, a single very broad series inferiorly.

In the collection of the British Museum, from Van Diemen's Land. From the Sydney Museum.

Mocoa metallica, n. sp.

Lower eyelid transparent; supranasals none. Scales distinctly four- or five-keeled, the projections being well defined but not sharp. Body stout, tetragonal; limbs rather short; ear-opening large. Nasals and fronto-nasals not contiguous; frontal short, triangular, of the same size as or smaller than the single fronto-parietal, which it joins with its truncated point. Supralabials six, the four anterior subequal, that under the eye more prolonged. Scales in 28 longitudinal series, the

two median dorsal being very broad; in a longitudinal ventral row there are 60, and these latter are smaller than the dorsal scales. Colours: above bright bronzed green, with a median dark brown stripe and lateral variegations more or less irregular; sides dark brown, broken up into irregular variegations; beneath greenish, dotted on chin.

In the British Museum, from Van Diemen's Land. Collected by R. Gunn, Esq.

In several other specimens (Dr. Millingen's collection) the ground-colour is much darker, and may be described as greenish brown, the pattern, however, being the same.

Mocoa pseudocarinata, n. sp.

Two small black skinks from Tasmania, also from Mr. Gunn's collection, present curiously ridged, or rather perhaps indented scales, three or four indentations being distinct towards the margin of all the scales, both dorsal and ventral. Lower eyelid transparent; no supranasals. Scales rather convex, distinct grooves between the series the whole length of the body. Fronto-parietals united in one specimen, in the other apparently separated by an irregular suture. Shining black above, with two narrow light stripes from head along the upper and lower margins of the sides. Scales in 28 longitudinal series, and 62 in ventral series.

Mabouya punctatissima, n. sp.

Supranasals narrow, oblique, contiguous; internasal broad, saddle-shaped; fronto-nasals contiguous, broad; fronto-parietals separate; supralabials seven, the five anterior subequal, that under the eye longer; ear-opening large. Scales moderate, rounded, smooth, equal all over the body; in 42 longitudinal series, 69 in a longitudinal ventral series. Hind legs not quite as long as the side, fore legs reaching to end of muzzle. Tail somewhat longer than head and body. Colour greenish brown, punctulated all over the upper surface with dark brown and occasional white dots; lower parts pale greenish.

The British Museum possesses one specimen of this form, which was purchased of M. Parzudaki, who gave the Cape of Good Hope as its locality, which we must consider very doubtful.

Euprepes fogoensis, D. & B.

Superficially resembling *E. Stangeri*, but with much smaller

scales, there being 56–60 longitudinal series, and 100 in a longitudinal ventral series. Scales two-keeled, uniform in size all over the body. Supranasals contiguous; fronto-nasals contiguous; fronto-parietals separate; supralabials six; ear-opening moderate, rounded, with small scales anteriorly. Limbs moderate. Tail somewhat longer than head and body. Colour olive-brown; two series of striæ, consisting of minute occellations of dark brown intersprinkled with whitish, forming almost two long stripes on each side of the back; sides brown, similarly variegated and mottled; belly pale; chin and chest variegated with brown.

Cape-Verde Islands. Many specimens, adult and young, from the islands of Fogo and St. Vincent's in the Cape-Verde group, from the collection of the Rev. R. T. Lowe.

By its two-keeled scales this species is allied to *Macroscincus Coctei*; but the teeth are not serrated.

Diploglossus millepunctatus.

Head elongate, flattened, broadening posteriorly; supranasals two pair, large, contiguous; nostrils in nasal shield, above suture between first and second labials, with a curved groove behind them; three large plates between eye and nasal; internasal broad, tapering posteriorly, separating the two long semirhomboidal fronto-nasals. Frontal a broad and long shield meeting by an obtuse point the narrow interparietal and separating two fronto-parietals; large rounded parietal plates. Supraorbitals four, with inner supraoculars; supralabials ten. Ear of moderate size, open. Scales of body and tail small, rounded, smooth or with striæ obsolete; in about 56 longitudinal series, and 64 in a median dorsal series from shoulder to groin, and 116 scales in a longitudinal ventral series. Colour dark brown, with an infinite number of minute white specks, one, two, or three on every scale. Fore limbs, laid forwards, not reaching tip of snout, hind limbs reaching halfway along sides of body.

Length of specimen 9 inches from tip of snout to root of tail.

From the north-west coast of America.

XLI.—*On the Invertebrate Marine Fauna and Fishes of St. Andrews.* By W. C. M'Intosh.

[Continued from p. 221.]

Subkingdom *MOLLUSCA.*

Section I. MOLLUSCOIDA.

Class I. POLYZOA.

The majority of the Polyzoa come from the deep water of the bay; and, indeed, there are comparatively few to be met with between tide-marks that do not also occur in the former. The minute animals of the calcareous masses so characteristic of many of this group, perform none of those alterations on the surface of the earth which the equally tiny coral-polyps daily effect; yet their workmanship in our northern waters is as regular and beautiful as that fashioned by the latter in the tropical seas. The patterns of the *Lepraliæ*, for instance, excite admiration; and though the apparent resemblance in growth, superficial aspect, and position may suggest to some an analogy between them and the lichens of our rocks and trees, yet it is remote and unable to bear close criticism. It is true it is difficult to assign an exact function to these organisms; but in some cases the calcareous crust of the *Lepraliæ* affords a better hold to many stationary marine animals than the rock itself. Moreover, after heavy-coated forms (like the *Balani*) have reared themselves on this basis, it frequently happens that the original crust is loosened from its attachment, and both fall off together. The coating of *Lepraliæ*, also, may prevent to some extent the disintegration of soft rocks and stones. By removing a portion of bark with an adherent *Balanus* from a submerged thorn-tree, and carefully detaching the former, a fine network of *Lepralia* is found lowest, then the calcareous coating of the *Balanus*; and if the latter has perished, a rough layer of *Cellepora pumicosa* obliterates all trace of it from without.

The Cheilostomatous Polyzoa are fairly represented; and several, e. g. *Flustra* and *Gemellaria*, occur in vast quantities attached to stones, shells, and corallines on the West Sands after storms. The majority are common to the eastern shores, the west, and the extreme north and south, as shown in the valuable catalogues of Messrs. Alder, Couch, Hincks, and Norman. Many species will doubtless yet be found at St.

Andrews—though at present they appear to be confined to the other areas, which have been more thoroughly investigated by observers specially skilled in this department. *Bicellaria ciliata* and *Bugula purpurotincta* seem to be more common at St. Andrews than in Shetland, the latter form being especially abundant and fine, and apparently taking the place of the *B. plumosa* of the southern shores; *Menipea ternata* and *Bugula Murrayana* are likewise in considerable profusion and in fine condition; while the southern *Flustra chartacea* is wholly absent. The species of the Membraniporidæ, perhaps, are more abundant in Shetland; and the *Lepraliæ* are decidedly more numerous there and in the extreme south. Amongst the more conspicuous forms we notice the entire absence of *Lepralia Pallasiana*, so common in the extreme west and south, and of the characteristic *L. innominata* and *L. figularis* of the latter. The Celleporidæ are abundant, but the species are few. *Cellepora avicularis* is exceptionally rich, according to Mr. Hincks; and the same high authority in this department states that the sole specimen of *Eschara Skenei* is fine.

The Cyclostomatous forms are not numerous; but all the examples are abundant; and the same may be said of the Ctenostomata. The late Dr. John Reid mentions *Vesicularia spinosa* as growing near low-water mark; but I have not been successful in finding it. The Zetlandic *Hornera* and the rich tufts of *Amathia lendigera*, so plentiful in the south, are altogether absent.

On the whole it would appear that the Hebridean, Zetlandic, and southern waters furnish a richer field for the Polyzoa than our eastern shores, not only as regards the number of species, but the condition and size of the specimens. I need only allude, for instance, to the luxuriance of the branching Celleporidæ and Reteporæ of the Hebrides and Shetland, and the extraordinary beauty and profusion of the Escharidæ and Lepraliæ, and indeed of the whole group, in the extreme south and in the Channel Islands, both between tide-marks and on the shell-banks around.

The arrangement followed is that of Mr. Busk in his accurate and well-known and beautifully-illustrated 'Catalogue;' and I have further derived great assistance from the valuable Catalogue of the Zoophytes of Northumberland and Durham by the lamented Joshua Alder, and the extensive Zetlandic lists by the Rev. A. M. Norman. I have also to thank Mr. Hincks for his kindness in revising the list and making several additions, and to acknowledge the information derived from his careful and original Catalogue of the southern forms.

Order GYMNOLÆMATA.

Suborder CHEILOSTOMATA.

Family Salicornariadæ.

Genus CELLARIA, Lamarck.

Cellaria farciminoides, Ellis & Solander; Busk, Catal. p. 16, pl. 64. f. 1–3, pl. 65 (bis). f. 5.

Attached to the roots of *Flustra foliacea* and other corallines; abundant in deep water.

Family Cellulariadæ.

Genus MENIPEA, Lamx.

Menipea ternata, Ellis & Solander; Busk, Catal. p. 21, pl. 20. f. 3–5.

Fine tufts on *Sertularia filicula* and other corallines from the deep water of the bay.

Genus SCRUPOCELLARIA, Van Beneden.

Scrupocellaria scruposa, L.; Busk, Catal. p. 25, pl. 22. f. 3 & 4.

Abundant under stones between tide-marks, and ranging to deep water. In October many are marked with the reddish orange ova; there are also many brownish black specks on these specimens.

Genus CANDA, Lamx.

Canda reptans, Pallas; Busk, Catal. p. 26, pl. 21. f. 3 & 4.

Found by Dr. John Reid near low-water mark (Anat. and Pathol. Observat. p. 602).

Family Scrupariadæ.

Genus SCRUPARIA, Oken.

Scruparia chelata, L.; Busk, Catal. p. 29, pl. 17. f. 2.

Common on *Ceramium rubrum*, *Sertularia pumila*, and other algæ and zoophytes between tide-marks.

Genus HIPPOTHOA, Lamx.

Hippothoa catenularia, Jameson; Busk, Catal. p. 29, pl. 18. f. 1 & 2.

On stones and shells from deep water; less common than the following species.

Hippothoa divaricata, Lamx.; Busk, Catal. p. 30, pl. 18. f. 3 & 4.

On stones and shells from deep water; abundant.

Family **Gemellariadæ.**

Genus GEMELLARIA, Sav.

Gemellaria loricata, L.; Busk, Catal. p. 34, pl. 45. f. 5 & 6.

Abundant in deep water, and thrown on shore in masses after storms.

Family **Bicellariadæ.**

Genus BICELLARIA, De Blainville.

Bicellaria ciliata. L.; Busk, Catal. p. 41, pl. 34.

Frequent on stones and shells from the coralline ground.

Genus BUGULA, Oken.

Bugula flabellata (J. V. Thompson, MS.), Gray; Busk, Catal. p. 44, pls. 51 & 52.

On *Flustra foliacea* from deep water; rather rare.

Bugula avicularia, Pallas; Busk, Catal. p. 45, pl. 53.

From the coralline ground, on *Flustra truncata*; not common.

Bugula purpurotincta, Norman, Quart. Journ. Micr. Sci. n. s. vol. viii. p. 219.

Abundant on the same ground, attached to shells.

Bugula Murrayana, Bean; Busk, Catal. p. 46, pl. 59.

Plentiful on the beach after storms, and at all times from the coralline ground.

Family **Flustridæ.**

Genus FLUSTRA, L.

Flustra foliacea, L.; Busk, Catal. p. 47, pl. 55. f. 4 & 5, pl. 56. f. 5.

Very abundant on the sands after storms.

Flustra truncata, L.; Busk, Catal. p. 48, pl. 56. f. 1 & 2, pl. 58. f. 1 & 2.

Common in the laminarian and coralline zones.

Genus CARBASEA, Gray.

Carbasea papyrea, Pallas; Busk, Catal. p. 50, pl. 50. f. 1–3.

After storms, and from the fishing-boats; not abundant.

Family **Membraniporidæ.**

Genus MEMBRANIPORA, De Blainville.

Membranipora membranacea, L.; Busk, Catal. p. 56, pl. 68. f. 2.

Abundant on the fronds of *Laminaria digitata* and other algæ.

Membranipora pilosa, L.; Busk, Catal. p. 56, pl. 71.

Very common on the stems and fronds of *Delesseriæ*, *Laminariæ*, and other seaweeds between and beyond tide-marks, and on shells and stones from the coralline ground.

Membranipora Flemingii, Busk; Catal. p. 58, pl. 61. f. 2, pl. 84. f. 4–6, pl. 104. f. 2–4.

Common on stones and shells from the coralline ground.

Membranipora Lacroixii, Sav.; Busk, Catal. p. 60, pl. 69, pl. 104. f. 1.

On the inner surface of a valve of *Cyprina islandica* from deep water.

Membranipora spinifera, Johnst.; Alder, Catal. Zooph. p. 53, pl. 8. f. 2, 2 *a*.

Abundant on the under surface of stones between tide-marks.

Membranipora Dumerillii, Aud.; Alder, Catal. Zooph. p. 56, pl. 8. f. 5.

Not uncommon on bivalves from deep water. As Mr. Alder observes, it may occasionally be seen in company with *M. Flemingii*.

Membranipora unicornis, Flem.; Alder, Catal. Zooph. p. 56, pl. 8. f. 6.

On bivalves from deep water; not very common.

Membranipora craticula, Alder; Catal. Zooph. p. 54, pl. 8. f. 3.

Occasionally in deep water.

Genus Flustrella, Gray.

Flustrella hispida, Fab.; Johnst. Brit. Zooph. p. 363, pl. 66. f. 5.

Abundant on the stems of Fuci and other seaweeds, and on stones between tide-marks.

Genus Lepralia, Johnst.

Lepralia Brongniartii, Aud.; Busk, Catal. p. 65, pl. 81. f. 1–5.

Rather plentiful on laminarian roots thrown on shore after storms. Often forms a basis for other growths, and may be seen on their under surface when detached from seaweed or rock.

Lepralia reticulata, J. Macgillivray; Busk, Catal. p. 66, pl. 90. f. 1, pl. 93. f. 1 & 2, pl. 102. f. 1.

Not uncommon in the siphons and inside the mouth of *Fusus antiquus*, and also on *Cardium echinatum* from deep water.

Lepralia concinna, Busk, Catal. p. 67, pl. 99.

Very abundant on stones and shells from the coralline ground. A well-marked variety, with perforations round the cells, is not uncommon.

Lepralia verrucosa, Esper; Busk, Catal. p. 68, pl. 87. f. 3 & 4, pl. 94. f. 6.

Occurs rather abundantly on the roots of *Laminaria digitata* and on stones near low-water mark.

Lepralia unicornis, Johnst.; Brit. Zooph. p. 320, pl. 57. f. 1.

A common littoral species, everywhere abundant, and in large patches on the under surface of stones. The colours vary, probably in some cases from the ova.

Lepralia spinifera, Johnst.; Busk, Catal. p. 69, pl. 76. f. 2 & 3.

Very common on the under surface of stones near low-water mark.

Lepralia trispinosa, Johnst.; Busk, Catal. p. 70, pl. 85. f. 1 & 2, pl. 98, pl. 102. f. 2.

Abundant on stones and shells from the coralline zone.

Lepralia coccinea, Abildgaard; Busk, Catal. p. 70, pl. 88.

• On sandstone, shale, and laminarian roots from the East Rocks, and on shells from deep water. Also found by Prof. J. Reid. Rare as contrasted with its profusion on our southern shores.

Lepralia linearis, Hassall; Busk, Catal. p. 71, pl. 89. f. 1–3.

Common on shells and stones from deep water.

Lepralia ciliata, Pallas; Busk, Catal. p. 73, pl. 74. f. 1 & 2, pl. 77. f. 3, 4, 5.

Occasionally on the under surface of stones near low-water mark; more frequently on stones and shells from the coralline ground.

Lepralia variolosa, Johnst.; Busk, Catal. p. 75, pl. 74. f. 3, 4, 5, pl. 75.

On shells and stones from deep water; not uncommon.

Lepralia nitida, Fab.; Busk, Catal. p. 76, pl. 76. f. 1.

Abundant both between tide-marks and in deep water, on stones and shells. The spines are in general less developed than in those from the Channel Islands.

Lepralia annulata, Fab.; Busk, Catal. p. 76, pl. 77. f. 1.

Instead of being partial to the laminarian blades, as on the west coast, this species is not uncommon on the under surface of stones between tide-marks, generally in small patches; and also occurs on shells and stones from deep water. Some dried specimens are of a pinkish colour.

Lepralia Peachii, Johnst.; Busk, Catal. p. 77, pl. 82. f. 4, pl. 97.

Common on stones near low-water mark, and on stones and shells from deep water.

Lepralia ventricosa, Hassall; Busk, Catal. p. 78, pl. 82. f. 5 & 6, pl. 83. f. 5, pl. 91. f. 5 & 6.

Not uncommon on stones and shells from deep water.

Lepralia punctata, Hassall; Busk, Catal. pl. 90. f. 5 & 6, pl. 92. f. 4, pl. 96. f. 3.

Everywhere abundant on the under surface of stones in pools and elsewhere near low-water mark, and also on shells and stones from deep water.

Lepralia Malusii, Aud.; Busk, Catal. p. 83, pl. 103. f. 1–4.

Not uncommon on shells and stones from deep water.

Lepralia granifera, Johnst.; Busk, Catal. p. 83, pl. 77. f. 2, pl. 95. f. 6 & 7.

Abundant on the under surface of stones near low-water mark in considerable patches. The aspects of the old and new cells differ much. The new cells glisten like those of *L. hyalina*, have a number of opaque white granules, a D-shaped aperture, and a distinct mucro; the transverse wrinkles of the cells are also apparent; and in some very new ones the granules are also glistening and hyaline, and show the perforations. In the old cells the walls are opaque, whitish, or yellowish, the granules still more opaque, perhaps larger, but less defined and beautiful.

Lepralia hyalina, L.; Busk, Catal. p. 84, pl. 82. f. 1–3, pl. 95. f. 3–5, pl. 101. f. 1 & 2.

Common on laminarian roots and stems, on *Delesseria* and other algæ, and on stones near and beyond low-water mark.

Family Celleporidæ.

Genus CELLEPORA, Fab.

Section A. *Incrusting, adnate.*

Cellepora pumicosa, L.; Busk, Catal. p. 86, pl. 110. f. 4–6.

Very abundant on stones, shells, zoophytes, and seaweeds—generally from deep water.

Cellepora avicularis, Hincks; Catal. Zooph. Devon, Ann. & Mag. Nat. Hist. 3rd ser. ix. p. 304.

Occasionally on zoophytes.

Section B. *Erect, branching.*

Cellepora ramulosa, L.; Busk, Catal. p. 87, pl. 109. f. 1–3.

Attached to the stems of zoophytes &c. in deep water; common.

Cellepora dichotoma, Hincks, Catal. Zooph., *loc. cit.* p. 305.

On zoophytes; abundant and fine.

Family **Escharidæ.**

Genus Eschara, Ray.

Eschara Skenei, Ellis & Sol.; Busk, Catal. p. 88, pl. 122.

A remarkably beautiful specimen on *Cyprina islandica* from the coralline ground.

Suborder **CYCLOSTOMATA**, Busk.

Family **Tubuliporidæ**, Johnst.

Genus Tubulipora, Lamarck.

Tubulipora serpens, L.; Johnst. Brit. Zooph. p. 275, pl. 47. f. 4–6.

On zoophytes and shells from deep water; very abundant and characteristic.

Genus Alecto, Lamx.

Alecto granulata, M.-Ed.; Johnst. Brit. Zooph. p. 280, pl. 49. f. 1 & 2.

On stones and shells from deep water; not rare.

Family **Diastoporidæ**, Busk.

Genus Diastopora, Lamx.

Diastopora obelia, Flem.; Johnst. Brit. Zooph. p. 277, pl. 47. f. 7 & 8.

On shells and stones from deep water.

Genus Patinella, Gray.

Patinella patina, Lamarck; Hincks, Catal. Zooph., *loc. cit.* p. 468.

Abundant on corallines and shells from deep water, especially on *Mytilus modiolus.*

Genus Heteroporella, Busk.

Heteroporella hispida, Flem.; Hincks, *loc. cit.* p. 469.

On stones and shells from deep water; rather rare.

Family **Crisiadæ.**

Genus Crisia, Lamx.

Crisia eburnea, L.; Johnst. Brit. Zooph. p. 283, pl. 50. f. 3 & 4.

On the under surface of stones between tide-marks, often

with many parasitic hydroids and Confervæ, and on zoophytes and seaweeds from deep water. Abundant.

Suborder **CTENOSTOMATA**, Busk.

Family **Alcyonidiadæ**.

Genus ALCYONIDIUM, Lamx.

Alcyonidium gelatinosum, Pallas; Johnst. Brit. Zooph. p. 358, pl. 68. f. 1–3.

On stones and bivalve shells from deep water; common.

Alcyonidium hirsutum, Flem.; Johnst. Brit. Zooph. p. 360, pl. 69. f. 1 & 2.

Abundant on seaweeds near and beyond low-water mark.

Alcyonidium parasiticum, Flem.; Johnst. Brit. Zooph. p. 362, pl. 68. f. 4 & 5.

Frequent on the stems of zoophytes from deep water; very characteristic.

Genus ARACHNIDIA, Hincks.

Arachnidia hippothooides, Hincks; Ann. & Mag. Nat. Hist. 3rd ser. ix. p. 471, pl. 16. f. 2.

On *Ascidia sordida* from deep water; in abundance.

Family **Vesiculariadæ**.

Genus VESICULARIA, J. V. Thompson.

Vesicularia spinosa, L.; Johnst. Brit. Zooph. p. 370, pl. 72. f. 1–4.

Found near low-water mark by the late Prof. John Reid.

Genus BOWERBANKIA, Farre.

Bowerbankia imbricata, Adams; Johnst. Brit. Zooph. p. 377, pl. 72. f. 5 & 6.

Abounds on the under surface of stones, on the stems and branches of littoral zoophytes, and on the tests of *Cynthia grossularia* under shelving rocks. Also found by Prof. J. Reid.

Order PHYLACTOLÆMATA.

Suborder PEDICELLINEA.

Family Pedicellinidæ.

Genus PEDICELLINA, Sars.

Pedicellina echinata, Sars; Johnst. Brit. Zooph. p. 382, pl. 70. f. 5.

On the branches of *Ceramium rubrum* and other littoral algæ and zoophytes; abundant.

Class II. TUNICATA.

Comparatively few Ascidians have been procured; indeed the department is in such a condition at present (as to specific identification) that a much greater amount of time would have been required for their elucidation than was available. The late Mr. Joshua Alder most kindly looked over the collection, and named those requiring identification in his usual conscientious manner; and it is to be hoped that the work on these forms by him and the late Mr. Hancock (one of the best minute anatomists this country has produced) will soon be published. The most abundant simple form is the *Ascidia sordida* of Alder and Hancock, which is thrown by storms on the West Sands in large numbers, attached to seaweeds, sticks, shells, and other objects. *A. intestinalis* is also procured in this manner as well as between tide-marks; *Pelonaia corrugata* and *Molgula arenosa*, A. & H., affect deep water only, and rarely occur during storms. The compound forms are common under stones between tide-marks and in the laminarian region: but much yet remains to be done in this respect at St. Andrews. Though Ascidians on the exposed parts of the east coast of Scotland are for the most part rare in the laminarian region and between tide-marks, they are common in still muddy waters on the west coast and in the Hebrides, and in water which cannot but be slightly brackish, as at the head of Loch Portan near Lochmaddy, where they are both abundant and large; they are also numerous and large between tide-marks at Herm and in the rich waters around the Channel Islands, as well as in the Zetlandic voes.

Family Botryllidæ.

Genus Leptoclinum, M. Edwards.

Leptoclinum durum, M. Ed.; Forbes & Hanley, Brit. Mollusca, i. p. 17 (as *L. aureum*, a misprint).

Common under stones in rock-pools between tide-marks. Dull yellowish white, with white specks from stellate calcareous crystals.

Leptoclinum punctatum, Forbes; F. & H. Brit. Moll. i. p. 18.

Not uncommon under stones between tide-marks.

Genus Botryllus, Gærtner.

Botryllus Schlosseri, Pallas; F. & H. Brit. Moll. i. p. 19, pl. A. fig. 7, pl. B. fig. 7.

Occasionally under stones between tide-marks. The red spot in the centre is not very visible in these specimens. On tearing, a dark brownish digestive system appears.

Botryllus polycyclus, Sav.; F. & H. Brit. Moll. i. p. 21.

Frequent near low-water mark on the under surface of stones, on Fuci and *Corallina officinalis*.

Genus Botrylloides, M. Edwards.

Botrylloides Leachii, Sav.; F. & H. Brit. Moll. i. p. 23.

Common in the laminarian region attached to seaweeds.

Numerous other species of *Botrylloides* and a *Didemnum* are common under stones in the rock-pools.

Genus Parascidia, Alder.

Parascidia Flemingii, Alder, Ann. & Mag. Nat. Hist. 1863, xi. p. 172.

Occasionally on laminarian roots near low water. Mr. Alder was of opinion that the drawing represented a young form of this species. It consisted of cylindrical animals with a transparent investment. On the summit of each are several long, ovate, reddish orange structures marked with yellowish white grains, showing at the free extremity an oral aperture surrounded by eight small papillæ.

Family **Clavelinidæ.**

Genus CLAVELINA, Sav.

Clavelina lepadiformis, O. F. Müller; F. & H. Brit. Moll. i. p. 26.

Occasionally between tide-marks.

Family **Ascidiadæ.**

Genus ASCIDIA, Baster.

Ascidia intestinalis, L.; F. & H. Brit. Moll. i. p. 31.

Abundant on the roots of tangles thrown on the West Sands after storms, and also under stones between tide-marks. Evinces considerable and spasmodic muscular contractions.

Ascidia sordida, Ald. & Hanc.

Very plentiful in the deeper water attached to stones, shells, sticks, and seaweeds. One has placed itself on the anterior end of an empty tube of *Pectinaria belgica* and quite filled it up. An elongated (club-shaped) variety is not uncommon.

Ascidia depressa, Ald. & Hanc.

Not uncommon on the under surfaces of large stones in tide-pools. In November specimens are often loaded with a pinkish-white creamy fluid, which appears to be made up chiefly of ova. The cellular border of each ovum is faintly greenish by transmitted light.

Genus MOLGULA, E. Forbes.

Molgula arenosa, Ald. & Hanc.; Alder, *op. cit.* p. 160.

Abundant in deep water, and in the stomach of the cod and haddock.

Genus CYNTHIA, Sav.

Cynthia, n. sp.

A nodulated Ascidian like a raspberry or small bramble occurred on the West Sands after a storm. Mr. Alder stated that it was not *C. morus*, but a species unknown to him.

Cynthia grossularia, Van Beneden; F. & H. Brit. Moll. i. p. 40.

Very common on the roofs of rocky ledges, between tide-marks, where it becomes incrusted by many parasites. The development of this species is easily observed.

Genus PELONAIA, Forbes & Goodsir.

Pelonaia corrugata, Forbes & Goodsir; F. & H. Brit. Moll. i. p. 43, pl. E. f. 4.

Frequent in deep water, and occasionally in the stomachs of the cod and haddock.

[To be continued.]

XLII.—*On the Spongozoa of* Halisarca Dujardinii. By H. J. CARTER, F.R.S. &c.

IN the 'Annals' for last year (vol. xii. p. 17) I published a paper on two new species of Gummineæ, with special and general observations. I had not then seen *Halisarca Dujardinii* of our shores, but have since met with it several times, always small, never more than from a quarter to three quarters of an inch in diameter.

I have also stated somewhere lately, with reference to the spongozoa, that what I claim is not to have shown that they were ciliated, but that they took in crude food and threw off the undigested portions like *Amœba*. This I have now also proved to be the case in *Halisarca Dujardinii*, in the following manner:—

Yesterday (March 19th) I went to the rocks here (Budleigh-Salterton), and found a specimen of *Halisarca Dujardinii*, about a quarter of an inch in diameter, on a bit of dead stick about the size of a tobacco-pipe. The stick was cut off to a convenient length and placed in sea-water; and thus, the following morning, it was brought under an inch compound power, when, seeing the particles of refuse matter actively issuing from the vent, I rubbed up a little indigo also in sea-water and, with a camel-hair brush, dropped it on the specimen, leaving it there about an hour, until I saw particles of the indigo itself issuing from the vent.

The water was then agitated so as to float away the superincumbent indigo, when it was observed that some of the *Halisarca* had become deeply coloured by it.

Now, taking off a portion of the coloured part, and tearing it to pieces with needles on a slide in sea-water, this was covered with a bit of thin glass, and placed under a $\frac{1}{4}$-inch compound power.

Thus the spongozoa of the *Halisarca* were brought into view. Some were isolated, others still remaining in their

natural groups. The isolated ones, which contained the indigo, were more or less globular, from 1 to 1¼ 6000th of an inch in diameter; provided with a short, pointed beak supporting a single cilium, about five times the diameter in length, and throwing out and retracting ray-like pseudopodia from their circumference, which was thus ever changing its form.

The "groups" consisted of an aggregation of such spongozoa charged with the indigo, and altogether formed round or elliptical dark blue masses, with a hollow interior and a circumference not only fringed with cilia, which were motionless, but also with a number of shorter ray-like pseudopodia.

The interiors appeared to be in direct communication with the branched system of excretory canals; but how the particles of indigo get from the pores to the canals I am ignorant. Possibly the pores and the canals may also be in direct communication, and cilia not only take the particles of food into the spongozoa, but, by reverse action, bring out the undigested parts by the same course.

Thus, however, in *Halisarca Dujardinii* the same kind of spongozoa exist as probably in all the other sponges, aggregated into similar groups, communicating respectively with the excretory system of canals.

I need hardly add that *Halisarca Dujardinii* is void of spicules, as Dujardin and Johnston have described it ('Annals,' *loc. cit.*), and not the spiculiferous sponge described by Dr. Bowerbank under this name. It is, *minus* the spicules, of the same structure as the Gumminеæ; and therefore all these gelatinous sponges may be assumed to possess the same kind of spongozoa (*vide* 'Annals,' *loc. cit.*).

XLIII.—*On a New-Zealand Whale* (Physalus antarcticus, *Hutton*), *with Notes.* By Dr. J. E. Gray, F.R.S. &c.

[Plate XVI.]

Prof. F. W. Hutton, keeper of the Otago Museum, Dunedin, New Zealand, has sent the skeleton of a whale taken Otago Head in October, 1873. He has also sent a slight account accompanied by a drawing of the whale, and the measurements of it when fresh, as follows:—

"Whale dark grey above, shading off gradually into yellowish white below. Baleen yellow with a narrow black margin.

	ft.	in.
Length along curve of back from end of caudal flipper to snout	16	$2\frac{1}{2}$
Straight	15	6
From snout to blowhole	2	5
From snout to eye	3	0
From end of caudal to dorsal	4	9
Girth at pectoral	10	0
Anterior margin of dorsal	1	3
Height of dorsal	0	7
Breadth "	1	0
Pectoral flipper, length	2	7
" breadth	0	8
Caudal flipper, length	1	6
" breadth	4	8
Weight	27 cwt."	

Mr. Hutton has considered this whale to be my *Physalus antarcticus*, noticed in the 'Zoology of the Erebus and Terror,' from a quantity of yellowish white baleen sold as New-Zealand whalebone. But the small size of the whale, only 16 feet long, and the baleen being described as yellow with a narrow black margin, makes me think it probable that the animal is the one which yields the long slender whalebone on which I established the pigmy whale (*Balæna marginata*), which, we know, inhabits New-Zealand, because Governor Grey found its skull on the island of Kawau; it was figured by Dr. Hector, and was constituted by me a genus, *Neobalæna* (see Ann. & Mag. Nat. Hist. 1870, v. p. 221, vi. p. 155, figs. 1 & 2).

If this should prove to be the case, it will be a very important discovery; for it will prove that the genus *Neobalæna* forms a group intermediate between the true whales and the finners (*Physalidæ*). The animal, though it has the throat and front part of chest plaited like the finners, has the large head and short body of the whales, the head being one fourth the entire length, and the caudal fin in breadth rather more than one fourth the entire length from end of tail.

It is to be regretted that Mr. Hutton did not describe the shape of the baleen—if it was short and broad like that of the finners, or long and slender like that of the Balænidæ.

The baleen on which I established *Physalus antarcticus* is short and broad, like that of a true *Physalus*, and evidently belonged to a much larger whale than the one from Otago Head.

Neobalæna, although it has the whalebone of the true Balænidæ, has a very peculiar kind of skull and ear-bone; and I should not be at all astonished to find that it has the plaited

throat and dorsal fin of a finner, combined with the short body and large head of a true whale (Balænidæ). The ear-bone is somewhat intermediate in form between the two groups, and fully justifies my opinion that when the entire animal and skeleton are known it may prove to be the type of a new family of whales (Suppl. Cat. Seals & Whales, p. 41).

I will describe the skeleton as soon as it arrives; for there is no doubt, from the proportion and size of the head and body, it is a new form of whale, if it is not *Neobalæna.*

XLIV.—*A Revision of the Genera* Epicharis, Centris, Eulema, *and* Euglossa, *belonging to the Family* Apidæ, *Section* Scopulipedes. By FREDERICK SMITH, Assistant in the Zoological Department of the British Museum.

Generic Characters of Epicharis, *Klug.*

Head not so wide as the thorax: eyes elongate-ovate; ocelli three, placed in a slight curve on the vertex: antennæ geniculate; the flagellum filiform, the first joint narrowed to its base: the labial palpi four-jointed, the two basal joints elongate, the first one third longer than the second, both flattened and membranaceous within; the third and fourth minute, attached near the apex of the second joint: the maxillary palpi two-jointed; the basal joint large, barrel-shaped, with its apex truncate, the second joint pear-shaped and minute: mandibles stout, with three blunt teeth at their apex. *Thorax*: the anterior and intermediate tibiæ with a single spine at their apex; the posterior tibiæ with two spines, the inner one pectinated: the anterior wings with one marginal cell, pointed at the base and rounded at its apex, having three submarginal cells, the first and second of nearly equal length, the second *narrowed towards the marginal cell*, receiving the first recurrent nervure a little beyond the middle; the third submarginal cell about two thirds of the length of the second submarginal, and receiving the second recurrent nervure near its apex.

The characters are drawn from *Epicharis rustica.*

An asterisk is prefixed to the descriptions of such new species as are in the collection of the British Museum.

1. *Epicharis rustica.*

Epicharis rustica, Latr. Encyc. Méth. x. (1825) p. 530; St.-Farg. Hym. ii. p. 170, ♀ ♂.
Apis rustica, Oliv. Encyc. Méth. iii. p. 8, ♀ (1792).
A. hirtipes, Fab. Ent. Syst. ii. p. 325 (1793).
Epicharis dasypus, Klug, Illig. Mag. vi.; Blanch. Hist. Nat. des Ins. iii. p. 405; Schomb. Faun. Flor. Brit. Guiana, p. 591.

Hab. Cayenne; Para; Catagallo; Venezuela.

2. *Epicharis Dejeanii.*

Epicharis Dejeanii, St.-Farg. Hym. ii. p. 171, ♀.
E. fasciata, St.-Farg. *ibid.* p. 172, ♂ (and type in coll. Westw.).

Hab. Amazons; Cayenne.

3. *Epicharis fasciata.*

Epicharis fasciata, St.-Farg. Hym. ii. p. 172, ♀ (nec ♂).

Hab. Rio Janeiro.

4. *Epicharis analis.*

Epicharis analis, St.-Farg. Hym. ii. p. 173, ♀.

Hab. ——?

5. *Epicharis umbraculata.*

Epicharis umbraculata, Klug, Illig. Mag. vi. p. 226.
Centris umbraculata, Fab. Syst. Piez. p. 355, ♀.
Epicharis cajennæ, St.-Farg. Hym. ii. p. 172, ♀ var. Type in coll. Westw.

Male: differs in having the basal joint of the antennæ white in front, a minute transverse spot above the clypeus, a line on each side of the clypeus, the labrum, and a spot at the base of the mandibles white; the posterior tibiæ are also yellowish white: in other respects the male resembles the female.

The *E. cajennæ* is certainly a variety of this species; I have compared the type specimens with others, which have the abdomen black and yellow. I have also seen intermediate examples.

Hab. Cayenne; Santarem.

6. *Epicharis bicolor.*

Epicharis bicolor, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 368, ♂.

Hab. Brazil.

7. *Epicharis zonata.*

Epicharis zonata, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 369, ♂.

Hab. Brazil.

8. *Epicharis elegans.*

Epicharis elegans, Smith, Journ. Entom. i. p. 152.

Hab. Mexico.

The female has the head, thorax, and legs black, the posterior tibiæ and basal joint of the tarsi with a dense brush of fulvous pubescence; the thorax is clothed with black pubescence. The male has the thorax covered with griseous pubescence, tinged with yellow above, and the clypeus, scape of the antennæ in front, base of the mandibles, base of the tibiæ, and apex of the posterior femora yellow; wings subhyaline.

*9. *Epicharis maculata.*

Female. Length 7 lines. Black; the labrum, a spot at the anterior lateral angles of the clypeus, a line at the inner orbits of the eyes terminating opposite the insertion of the antennæ, and a minute spot at the base of the mandibles yellow; the labrum with a narrow rufous margin, and fringed with hairs of the same colour. Thorax: a minute spot on each side of the collar, two on the tegulæ, one at the extreme base of the wing, and two on the scutellum yellow; a yellow spot at the base of the posterior tibiæ above; the posterior tibiæ and tarsi ferruginous, and densely clothed with fulvous pubescence; wings subhyaline, faintly clouded at their apex, the nervures fusco-ferruginous. Abdomen: the basal segment rufo-fuscous, the three following yellow; the second and third segments have on their apical margins a broad black fascia, which is widest in the middle, narrowing abruptly towards the lateral margins, to which they do not extend; the apical segments more or less ferruginous.

Hab. Mexico (Oajaca).

*10. *Epicharis scutellata.*

Female. Length 9 lines. Black; head shining, the clypeus prominent, a transverse minute pale yellow spot on each side of its anterior margin, a similar spot above it; a line at the inner margin of the eyes, not extending above the insertion of the antennæ, and the sides of the labrum yellow; the tips of the mandibles testaceous. Thorax clothed with short cinereous pubescence; the legs rufo-piceous beneath; a minute white spot at the base of the anterior and intermediate tibiæ outside; the posterior tibiæ and basal joint of the tarsi densely clothed with fulvous pubescence; the scutellum naked, flattened, deeply notched behind, and forming two horse-shoe shapes; wings dark fuscous. Abdomen slightly shining, and having an interrupted yellow fascia at its basal margin; the three following segments with an oblong oblique yellow macula, pointed at its apex within, the first much larger than either of the following, the third sometimes obsolete; the fourth and fifth segments with their apical margins more or less testaceous; the sixth, as well as the apical margins of the segments beneath, rufo-testaceous and fringed with pale fulvous pubescence.

Hab. Brazil (Tunantins, Amazon).

*11. *Epicharis affinis.*

Female. Length 9 lines. Black; head slightly shining; the clypeus and labrum strongly punctured. The insect

otherwise closely resembling *E. scutellata*, from which it differs in having the scutellum rounded behind; the legs dark rufo-piceous; the tibiæ have no spots at their apex; the abdomen is black-brown, and the basal segment of the abdomen is immaculate, the apical segment has no pale pubescence, and the fringe on the segments beneath is dark brown.

Hab. Brazil (Tunantins, Amazon); Bahia.

A specimen from Bahia has the lateral maculæ on the second segment larger, and has a narrow fascia at the basal margin of the third segment.

*12. *Epicharis conica.*

Female. Length 9–10½ lines. Head and thorax black, the abdomen ferruginous, the flagellum of the antennæ obscurely ferruginous beneath. Thorax shining and impunctate, the sides and the metathorax posteriorly clothed with sooty-black pubescence; all the femora ferruginous beneath; the posterior tibiæ and the first joint of the tarsi ferruginous, and clothed exteriorly with dense pale fulvous pubescence; wings fusco-hyaline. Abdomen conical, ferruginous, the posterior margins of the segments usually more or less fuscous; palest beneath, and with the apical margins of the segments fringed with bright fulvous pubescence.

Male. A little smaller than the female; the labrum, and scape of the antennæ white in front; the first joint of the intermediate tarsi above, the posterior tibiæ, and first joint of the tarsi fringed above with fulvous pubescence; the posterior tibiæ in front pale ferruginous; the tarsi bright yellow in front, and the first joint terminating at its apex in a sharp spine; the claw-joint elongate. Otherwise like the female.

Hab. Brazil (Villa Nova, Para).

*13. *Epicharis albofasciata.*

Male. Length 5¾ lines. Black; the labrum, an interrupted transverse line on the clypeus at its apical margin, its sides, and a line on the mandibles yellow; the scape of the antennæ in front white, the flagellum fulvous beneath. Thorax: an abbreviated line on each side of the collar, a spot on the tegulæ (which are testaceous) in front, another behind, and the posterior half of the scutellum yellow; wings subhyaline; legs ferruginous, and more or less fuscous above; the posterior tibiæ and first joint of the tarsi fringed above with sooty-black pubescence; the claws of the tarsi black. Abdomen black above and rufo-testaceous beneath; above, the second segment with a narrow white fascia near its basal margin, the fourth

segment with a narrow yellow fascia at its basal margin, usually more or less interrupted in the middle; the fifth segment has a similar fascia; the apical segments are reddish yellow; the fascia on the fourth segment is frequently obsolete.

Hab. Brazil (St. Paulo, Para).

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

Synopsis of the Acridıdæ *of North America.* By Cyrus Thomas, Ph.D. *Being Part I. of the Fifth Volume of the 'Report of the United-States Geological Survey of the Territories,' issued by the Department of the Interior.* 4to: Washington, 1873.

There is one particular in which the Government of the United States puts those of European countries to utter shame. This is the liberality shown in America in the promotion of scientific research, both by the central Government and by the Legislatures of the various States. All over the States geological surveyors are hard at work; and the results of their labours are given to the world in a constantly increasing series of valuable volumes, which are most liberally circulated gratuitously in other countries. With a breadth of view which deserves all praise, the geological surveyors do not confine themselves to mapping the geological formations of various districts, and describing the fossils obtained from them, but they devote a good deal of attention to the recent productions of the regions traversed by them; and the results of their investigations are published from time to time at the public cost, and as an integral part of the work properly belonging to the surveys.

Dr. Thomas's "Synopsis of the Acrididæ of North America" is one of those publications, and it forms the first part of a volume which is to be devoted exclusively to the recent zoology and botany of the United States. After giving a list of works on the Orthoptera referred to in his monograph, the author describes, in considerable detail, the external and internal structure of the insects belonging to the family the American species of which form its subject-matter. This introduction, which is illustrated with two outline wood-engravings, furnishes a guide to the terminology of the parts in those insects.

With regard to the oviposition of the Acrididæ, Dr. Thomas states that the destructive migratory species of the West (*Caloptenus spretus*), like the migratory locusts of Europe, deposits its eggs, to the number of 50 or 100, in a cocoon-like mass, covered with a tough glutinous secretion, but that this method is by no means followed by all other American species. Even the red-legged locust (*Caloptenus femur-rubrum*) was found by him to lay its eggs loosely in rotten wood.

Dr. Thomas enters at great length into the question of the classification of the Orthoptera, and gives a complete revision of all the more important systems which have been proposed by various authors, from Linnæus downwards. His final result is an adoption of Burmeister's classification of the families, except that he includes the Forficulidæ, placed by Burmeister as a distinct tribe. He divides his Acrididæ into two subfamilies, the Acridinæ and the Tettiginæ, and the former again into seven groups, as shown in the following Table (p. 40):—

I. Anterior margin of the prosternum truncate, not elevated; claws furnished with pulvilli; pronotum shorter than the abdomen	Subfam. 1. ACRIDINÆ.
A. Antennæ 6–8-jointed, not longer than the head	Group 1. *Proscopini.*
AA. Antennæ multiarticulate, longer than the head.	
a. Head produced in front in the form of a cone or pyramid; face very oblique; antennæ ensiform, triquetrous.	
b. Elytra narrow	Group 2. *Tryxalini.*
bb. Elytra very broad	Group 3. *Trigonopterygini.*
aa. Face suboblique or vertical.	
b. Antennæ filiform, subdepressed, or clavate; joints indistinct.	
c. Prosternum unarmed	Group 4. *Œdipodini.*
cc. Prosternum spined............	Group 5. *Acridini.*
bb. Antennæ acuminate; joints distinct; front more or less advanced between the antennæ, in the form of a blunt cone.	
c. Joints of antennæ flat	Group 6. *Xiphocerini.*
cc. Joints of antennæ terete..................	Group 7. *Phymatini.*
II. Anterior margin of the prosternum elevated; claws without pulvilli; pronotum extending to the tip of the abdomen..............................	Subfam. 2. TETTIGINÆ.
A. Prosternum unarmed	Group 8. *Tettigini.*

Mr. Walker's Pamphagidæ are included in the group Xiphocerini. Five of the above groups have representatives in the fauna of the United States, the first, third, and seventh being deficient. In the present work, however, Dr. Thomas works out the genera and species only of four groups, the Tettiginæ being described chiefly from the writings of previous entomologists.

The author tells us that the number of species of Acrididæ (exclusive of Tettiginæ) known to occur in the United States is about 120, belonging to 25 genera. The number described in Fischer's 'Orthoptera Europæa' (1853) was 77, belonging to 20 genera. The total number of species (including 20 Tettiginæ) found in the North-American region (taking in British America, Mexico and Central America, and the West Indies) is 227; these belong to 45 genera, 4 of which are Tettigine. Characters of these, principally compiled from the writings of other authors, are given as a sort of appendix to the body of the "Synopsis." Of the 120 species inhabiting the United States, 40 have been described as new by the author in this and former memoirs; and he tells us that many of these have been figured by Professor Townend Glover in a lately

published work, entitled 'Illustrations of North-American Entomology,' which we have not seen.

Of course any special criticism of this work is quite out of the question, unless one were prepared to go through nearly the same amount of labour that the author has bestowed upon it. The genera and species are most carefully characterized, tables are freely introduced to facilitate their determination, and the whole book bears the impress of most conscientious work. Here and there we seem to see indications of a desire to draw the line of specific distinction too tightly; but without a knowledge of the species it is of course impossible to pronounce a decided opinion upon such matters; and we can only welcome Dr. Thomas's memoir as a most important contribution to our knowledge of American entomology. It is illustrated with a nicely executed plate of outline figures, designed to show the general characters of a few of the genera referred to.

MISCELLANEOUS.

Eozoon canadense. By Prof. Max Schultze.

The discovery of the American geologists Sir William Logan and Prof. Dawson with regard to a peculiar fossil in the primæval limestones of the oldest formation of Canada, which they thought must be referred to the Foraminifera, and named *Eozoon canadense*, has obtained a provisional settlement by the investigations of Dr. W. B. Carpenter, of London, whose extensive works upon the Foraminifera are recognized as occupying the first rank. Carpenter considers there is no doubt that the discoidal masses, about a foot in diameter and several inches thick, composed of alternate layers of greenish silicates (serpentine or augite) and carbonate of lime (or magnesia), which, caked together into irregular nests, occur in the Laurentian deposits of Canada hitherto regarded as perfectly azoic, represent the remains of a many-chambered Foraminifer of the habit of the Acervulinæ, M. Schultze. Like the glauconitic filling of more recent Foraminifera, the serpentinous mass of the *Eozoon* has penetrated into the interior of the chambers, while the intervening calcareous bands represent the original calcareous walls of the chambers. In these, in well-preserved specimens, there is a complex, ramified canal-system, connected with the original cavities of the chambers, and filled, like these, with a silicate which is insoluble in acids. Carpenter compares them to the canals detected in various fossil and recent Foraminifera, which occur arranged in bundles, as, for example, in *Calcarina* or *Siderolites calcitrapoides* from the chalk of Maestricht.

The statements of the above-mentioned English and American observers have been received with much mistrust, especially in Germany. In fact there can be no doubt that much of what has been given out as *Eozoon* shows no kind of organic structure when examined under sufficiently high powers. The author therefore

thought it important to make a fresh examination of admitted original specimens. Such a specimen, transmitted directly by Dawson, was placed at his disposal by Professors Schimper and Benecke, on the occasion of his visiting the museum at Strasburg. From his investigation of this specimen and of some received from Carpenter, the author confirmed, and showed in numerous drawings, the presence of a highly developed canal-system in many of the calcareous bands, especially the broader ones. The form and arrangement of these canals is often beautifully preserved, even though their interior is filled with a crystalline silicate. Here and there the structure has the greatest resemblance to that of the dentine of the teeth, which is also traversed by canals. But for many reasons there can be no question of dentine in this case. The application of stronger powers shows that in the finer structure of the canals there is so great an agreement with that of *Polytrema* among the living Acervulinæ, that, weighing all the other conditions of structure which come into consideration, there can be no serious doubt as to the foraminiferous nature of *Eozoon canadense.—From a report of the Meeting of the Niederrheinische Gesellschaft für Natur- und Heilkunde at Bonn, July* 7, 1873, *in the* '*Kölner Zeitung*,' August 14, 1873.

Notes on the Skulls of two undescribed Species of Sea-lions (Otaria). By Dr. J. E. Gray, F.R.S. &c.

The British Museum has a series of fourteen skulls of the common sea-lion, from the largest size (16 inches long) to that of the pups, and of both sexes.

They are all characterized by their short, broad lower jaws, the space between the under part of the two sides being bowed out, and the lower margin, from the gonyx to the angle of the jaw, being of the same length as the space between the two jaws at the angle.

The lower jaws are swollen on the sides and broad in front. The scar of the temporal muscle on the hinder part of the lower jaw is broad, rounded in front. There are specimens in the Museum from various parts of South America, as Peru, Chili, the Falkland Islands, and the Coast of Patagonia.

The skulls of the young and of some of the older ones have the sixth upper grinder behind the back edge of the front of the zygomatic arch; but in the skulls of the aged animals the zygoma is dilated, and the tooth comes to be partially or entirely before the hinder edge of the zygoma, sometimes differing on the two sides of the same skull.

In the British Museum there are two skulls of adult animals which differ in having the lower jaws straight, not bowed on the side, and elongate, the lower margin from the angle to the gonyx being considerably longer than the space between the two sides of the jaw at the angle, and the front of the lower jaw flattened on the sides, and the scar of the temporal muscle is elongate, narrow in front. I propose to name them

Otaria minor. The Smaller Sea-lion.

Skull of an adult male 11½ inches long, and 6½ inches wide at the condyles; the nose dilated in front; the palate very deep, wide, broad in front, contracted behind, with the lateral processes rather contracted, the sixth upper grinder behind the edge of the front of the zygomatic arch; the lower jaw 8½ inches long, wide and strong, contracted and flat on the sides in front, and with an elongated scar behind left by the temporal muscle.

Hab. Unknown. Received from Mr. E. Cross, 1854.

This skull may be the same as *Otaria Godeffroyi*, Peters, described and figured from a specimen in the museum at Hamburg, which is about the same size; but the lower jaw is not of the same shape as the lower jaw of the skull in the Museum, the scar of the large temporal muscle is broad and rounded at the end, as in the jaws of the common sea-lion, and the sixth upper grinder is before the back edge of the front of the zygoma; so that I am inclined to think that the Hamburg skull belongs to a small species allied to, or is a small variety of, the common sea-lion (*Otaria jubata*).

Otaria pygmæa. The Pigmy Sea-lion.

The skull of an adult (female) 9¼ inches long, and 5¼ broad at the condyles.

The palate is very narrow, deep, scarcely wider behind; the sixth upper grinder is behind the hinder edge of the front of the zygomatic arch. The lower jaw is comparatively slender, 6½ inches long, compressed and flat in front.

Hab. Unknown. The specimen was received from the Zoological Society in 1858.

This skull is partly broken behind, and wants all the grinders and the greater part of the cutting-teeth. The canines are comparatively small, which makes me think that it belongs to a female; indeed I might regard it as the female belonging to the same species as the skull before described, but for the peculiar form and narrowness of the palate.

The palates of the two sexes of the common sea-lion are of the same form, though they become deep with age and those of the males more contracted behind; so that they give no authority for believing that the palates of the two sexes of an allied species are so different.

The Succession of Life in North America. By Edward D. Cope.

The United States east of the Missouri river and the plains have been free from changes of level for a much longer period than that portion which lies to the west of such an imaginary line. It was alternately dry and submerged during a long period in the infancy of geological time, but became finally so established as to permit of no further descent of level, or, at most, of slight ones only. The last stages of this process of creation were witnessed at the close of the Carboniferous period, when the elevations of land were wide-spread, inclosing tracts of water within bars or in depressions.

These water areas were of course at first salt; but, as they had no communication with the sea and received abundant supplies of pure water from streams and rains, they soon became fresh. They then became the centres of rank vegetation, which either as moss filled them up with its dense growth, or as large trees formed forests on the shores. Later submergences covered all this material with a heavy coating of mud-deposit, which now appears to us in the form of strata of clay and sandstone rock. Thus was produced the coal, which has played so important a part in human progress. So frequent were the alternations of level that at one place in Nova Scotia as many as seventy-six beds of coal separate as many strata of other materials, and the whole amount of deposit amounts to fifteen thousand five hundred feet. As the elevating force became more powerful, the amount of dry land increased, until the lifting of the Alleghany Mountains to a height of twenty thousand feet concluded the process.

Previous to this time vertebrated animals had been inhabitants of water only, so far as the preserved remains have been discovered; but now air-breathers were introduced, which, instead of fins, possessed limbs adapted for walking on dry land. These creatures were all salamanders, and related to the frogs, beginning life in the water and passing through a metamorphosis before reaching the perfect state.

The western regions were during this time occupied by a boundless ocean, whose western limit has not yet been ascertained; and such it continued for many ages, while the east was bringing forth plant and animal each after its kind. The strata deposited in the bottom of the western sea covered each other successively, so that it is only the later chapters of the history that are now revealed to us in the exposed beds of the upper formations. But the history of the east was repeated. Its eastern coast-line rose and fell gradually and islands appeared in the far west, heralding the birth of another continent. Slowly the land areas extended, the western growing from islands to a long narrow continent, honeycombed with lagoons and lakes. The great central sea (now Kansas, Dakota, &c.) contracted and finally lost its connexion with the ocean altogether. The water areas, however, were for a long period brackish, and brought forth oysters and other shell-fish of dubious proclivities, capable of living in either salt or fresh water, but thriving in a mixture of both. The land was covered with a rich and dense forest vegetation, and the bog-moss again encroached on the lakes; but the forest was in great contrast to that of the carboniferous period. Instead of huge ferns and tree mosses we have the more highly organized and beautiful forms represented by the existing deciduous trees. Oaks, sassafras, magnolia, and poplar shaded a dense undergrowth of shrubs, while palms and some other tropical families distinguished the general effect from the familiar one of to-day. But the moss performed its old function of coal-maker. Humblest among plants, its existence has been more important in world-building than that of all the lords of the forest. Its masses died,

and new layers of the living plant grew upon them, until the descent of the land and encroachment of waters deposited the stone lid upon their treasury of carbon, not to be unsealed until the long future day of human empire. The alternations of land and water were numerous. At one point on the Union Pacific railroad a section displays one hundred and seventy-three distinct strata, of which thirty-six are either coal or mingled with vegetable matter, while the others are frequently composed almost exclusively of fresh- and brackish-water shells. The elevation, however, exceeded the depressions, the brackish estuaries and lagoons were transformed into freshwater lakes, and at length the noble ranges of the Rocky Mountains bounded the horizon in many directions.

The salt ocean has not only been the dwelling-place of gill-breathing fishes, but also of many forms of air-breathing vertebrates. These were reptiles, and exhibited a great superiority of structure over the air-breathers that peopled the swamps and land of the coal period. When the land and the fresh waters claimed the great west, the sea saurians perished; for their limbs were not fitted for the changed circumstances. Smaller races held the land, and, with a few monsters that never had been ocean-dwellers, represented the swarming reptilian life of the past.

But a new dynasty was to rule the earth; the mammal, with hot blood and active brain, was to use the rich stores of the newer vegetable world; and life was to be exhibited on a higher platform.

The lakes of the west were gradually dried by the cutting of their discharging streams down to the level of their bottoms. This was of course soonest accomplished in lakes of the greatest elevation—for instance, those within the highest range of the mountain-chains. Others continued for a longer period, and others to a comparatively still more recent date. Their deposits contain a faithful record of the life of the surrounding land, doubtless embracing many species that ranged to the Atlantic ocean. We have thus the means of studying the character of five successive periods, which must be to us a mine of interesting inquiry, and a source of evidence as to the nature of that life and the thoughts of its great Author.

The names of the beds, with the regions where chiefly found, are the following:—(1) The Lignite series or Upper Cretaceous (Montana, Dakota, Wyoming, Colorado); (2) Eocene Lake (Wyoming, West Colorado); (3) Miocene (Nebraska, Oregon, E. Colorado); (4) Pliocene (Nebraska, Idaho, Oregon, E. Colorado); (5) Post-pliocene (caves of the east). The quadrupeds begin in full blast in the Eocene; and none whatever are known from beds of the preceding or cretaceous agea—a remarkable circumstance, and not easy to account for, especially as it is the case all over the world, so far as known; yet there were a few of this high division during a period that preceded the cretaceous. In Wyoming, therefore, we find life first in the form with which it has pleased Divine power to invest ourselves, but in no case presenting any close resemblance to the human species. The predominant styles were those resembling the tapir, the opossum, the bat, the mole, and the squirrel. There were

no cloven-footed animals that chew the cud (ruminants), no horses, no elephants, no rhinoceros or hippopotamus, and, it is thought, no true cat- or dog-like flesh-eaters. To take their places were strange creatures that combine the characteristics of these divisions now so widely separated. Thus there were forms between the horse and tapir, between the elephant and tapir, and between the rhinoceros and tapir. There were numerous monkeys which resembled nearly as much the raccoon and the coati. The land carnivora resembled in many ways the seals; and the division of the opossum and the kangaroo had sundry representatives. A more curious and, to some, unexpected faunal combination, constituting a homogeneous whole, does not exist in any known formation.

In the next period (Miocene) a great addition to the living types of animals took place; so that the contrast between this formation and the Eocene is very great. A portion of almost any part of the skeleton of a quadruped would thus enable the palæontologist to determine the age of the formation from which it had been procured. Thus ruminating animals exist in the greatest profusion, a few horses appear, two species of elephants (mastodon) are known, and there are a great many species of rhinoceros. The peculiar intermediate divisions of the Wyoming beds no longer peopled the land; the strange beings compounded with the tapir have abandoned the earth in favour of more decided types. One or two tapirs hold over, and one of the anomalous monkeys. The snakes and lizards are nearly the same; but the crocodiles that swarmed during the Eocene have entirely disappeared.

If we examine the character of the representatives of living orders in greater detail, we shall find the phenomenon observed in the structure of the Eocene quadrupeds repeated, but within a narrower limit of variation. Thus the modern ruminants may be roughly stated as belonging to the families of the hogs, camels, musk-deer, and oxen. In the Miocene there are neither oxen nor deer, while many species in enormous droves present structure of hog, camel, and deer combined, or camel plus musk and hog. The horses had three toes and were more or less like tapirs; and some of the rhinoceroses shared similar peculiarities. One strange set of creatures combined characters of tapir and rhinoceros with those of those Eocene beasts that combined the elephant and tapir. The latter have been called *Eobasileus*, the former *Symborodon*. The *Eobasileus* had three pairs of long horns—the first at the snout, the last on the back of the skull; the feet were like the elephant's; and it carried a pair of knife-like tusks. It probably had a short trunk. The *Symborodon* had feet more like the rhinoceros, but it stood high on the legs like the elephant; the tusks were reduced to a small size, while one pair of horns stood upon the top of the head. They represented the front pair of the *Eobasileus*, and either stood on the nose or over the eyes. Their shape differed in the different species: in some they were long and round, in others flat; in others they were three-sided and turned outward. One species had enormously expanded cheek-bones, and was nearly as large as

an elephant; it has been called *Symborodon bucco.* The long-horned species was as large as the Indian rhinoceros, and is called *Symborodon acer.* The species with three-cornered horns is intermediate in size.

Besides these larger quadrupeds there were myriads of the small ones, whose evident adaptation for insect- and seed-eating habits indicate the abundance of such supplies. Thus there were moles, mice, squirrels, and not less than seven species of rabbits. Areas exist where the beds of the formation laid bare by the weather are found to be covered with the delicate remains of these animals. They cover the surface in such profusion as to resemble the loose grain on the farmer's barn-floor in harvest time.

The Pliocene stratum, above the Miocene, is usually present in the regions where the latter occurs, though not invariably. It has a more sandy character, while the older beds are more clayey. The life they disclose is quite distinct from that we have just passed in review, differing from it much in the same way that it differs from that below it, *i. e.* the Eocene. In other words, it is still more like the life of the present time, and the curious intermediate or (to speak inaccurately) the mixed divisions have nearly disappeared. We have now true dogs and weasels, true elephants, and a few true deers and antelopes. The camels are almost like those now living; and while the horses have three toes, the side toes are much reduced, and the teeth are much more nearly like those of living horses. Rhinoceroses still abound; but all their mixed tapiroid and elephantine kindred have utterly disappeared.

A curious feature in the dentition of the horses and camels of this period has been observed. The temporary or milk-teeth of the horses were very much like the permanent or second series of the horses of the preceding or Miocene formation. The second or permanent teeth differed from them, and resembled exactly in type the temporary or milk-teeth of the living horses. The case of the camels is similar. Like the hogs they possessed a full set of upper teeth in front, which they soon shed, thus taking on one of their true camel characters; but their permanent series all round after this shedding was like that of the milk-dentition of the existing camels and llamas. In the latter animals the number of the permanent teeth is less than that of the first series in one part of the mouth, thus producing another type.

In the fifth and last period we observe another marked change in the life. Most of the Mammalia are nearly related to those now living in this and other continents, while a great many forms of the past are lost. The monkeys did not reach into the Pliocene, so far as we know; now the rhinoceros leaves us. A few remnants only survive of the camels and horses. Oxen first appear either as the giant bison or the southern musk-oxen; deer of great size exist. The loss is replaced by South-American types, especially gigantic sloths, in great abundance, with droves of tapirs and peccaries. For the first time we have the raccoons and bears, the latter of the same character as those found with the fossil sloths in Buenos Ayres.

True cats, like the jaguar and the tiger, roam the forests; and weasels and otters inhabit the banks of the streams.

The modern time has come, so far as the patterns of the animals are concerned; but their habitations are still different from those which their representatives preserve at the present day. But nearly all the post-pliocene quadrupeds belong to different species from those now living.

The present appearance of the mammalian family in North America is due to the following changes:—The llamas, sloths, tapirs, and peccaries have all been banished to Mexico and South America; so also most of the large cats. The horses, mastodons, and elephants were extinguished. The deer type seems to have expanded, while one ox (the bison) and an antelope remain. The wild dogs, weasels, &c. number about as many species now as in the past, while the variety of bears seems to have increased; on the other hand only one of the large cats (the puma) remains. That strange creature the opossum still holds his own far away from his Australian kindred. The smaller rodent quadrupeds are almost as much varied as ever. Many of these changes have evidently been wrought by the glacial period. That frozen epoch brought down the arctic life, and either destroyed those forms that could not resist its rigours, or drove them into a more southern climate. The musk-ox then roamed through the southern States; the walrus haunted the coasts of Virginia; and the reindeer peopled New Jersey. With the return of the milder period these again sought the north.

But a small proportion of the actual number of the species which lived during these successive ages is yet known, and the field offers many returns for exploration. As an illustration of the manner in which opinions respecting the history of life may be corrected by discovery, I cite two examples. The bony gar-fishes have been often pointed to as exhibiting a remarkable break in the times of appearance in geological history. Their latest fossil relatives were known to have existed during the ancient period called the jurassic; they did not recur until the present, and now only in the fresh waters of North America. This break of at least one third of all geological time has been recently much reduced by the discovery of gars in great abundance in the Miocene and Eocene periods on this continent. The second case is that of the serpents. They were only known for a long time in the Eocene of New Jersey, then in the same epoch of Wyoming, and lately in the Miocene of Colorado.

Until recently no fossil monkeys, bats, or opossums were known to exist in American formations; and the curious intermediate divisions above described as related to elephant, rhinoceros, tapir, hog, camel, horse, monkey, &c. are all recent American discoveries. —*The Penn Monthly*, Feb. 1874.

On Xenelaphus, Furcifer, *and* Coassus peruvianus *of the Peruvian Alps.* By Dr. J. E. Gray, F.R.S. &c.

Mr. Whitely has sent to the British Museum the skins and skulls of a male and female Peruvian deer from Ceuchupate, Peru, at an elevation of 11000 feet.

The male, which he calls "Oieidos," is evidently the same animal as I described (from specimens which he had previously collected) as *Xenelaphus chilensis* (Ann. & Mag. Nat. Hist. 1873, xii. p. 161), and as the male of the young animal which MM. Gay and Gervais had described in the 'Ann. Sci. Nat.' 1846, p. 21, and figured with the skull in the Atlas to Gay's 'Chili.' They live in large troops.

Mr. Whitely's specimen shows that the horns of the animal which I described as *Xenelaphus* are probably a malformation both in form and surface: for they were covered with beads, whereas the horns of the specimen just received have a simple, subulate, slightly grooved beam 9 inches long, with a brow-antler of the same form 6 inches long, curved upwards and inwards at the tip.

The colouring of the face and shape of the horns of Mr. Whitely's specimen agree with the figure of *Cervus antisiensis* given in the 'Atlas' to D'Orbigny's 'Voyage dans l'Amérique méridionale,' t. xx., published in 1847. The skull of this animal does not seem to have been observed; but it probably represents the same species as *Cervus chilensis* of Gay and Gervais.

As the genus *Furcifer* of Sundevall was established for the *Cervus antisiensis* of D'Orbigny, and restricted by me to the guemul, it will have the priority and take the place of the genus *Xenelaphus*, established on an animal that probably has anomalous horns.

MM. Gay and Gervais published the account of *Cervus chilensis* in 1846; and Gay afterwards figured the skull, which leaves no doubt about the identity of the species. Their specific name will have priority, and the animal will have to be called *Furcifer chilensis*.

The female specimen, which is named "Venados," is much smaller and has a softer fur; they live always in pairs, and never mix with the Oieidos. It has the general colouring of the "Oieidos" (*Furcifer chilensis*), but the top of the face is blackish. This specimen is accompanied by its skull, and is evidently the same species as the skull of a female obtained from Mr. Whitely in 1873 from Peru, which is figured in the 'Hand-list of Ruminants,' t. xxxv. fig. 2, and as the skull of a male with deformed horns, received from the Zoological Society under the name of *Cervus antisiensis*, and figured in the 'Hand-list,' t. xxxv. fig. 1,—both as *Furcifer antisiensis*. These skulls differ from *Xenelaphus chilensis* and *Huamela leucotis* in having only a small shallow tear-pit, whereas those animals have a large deep one.

There is no doubt that the "Venados" of Peru is quite distinct from all the other South-American deer or skulls of deer that we have in the Museum. The skulls agree with those of *Coassus* in the small size of the tear-pit; but I do not venture to decide to what genus the only male skull that we have with deformed horns is to be referred, but will denominate it *Cervus* (*Coassus*) *peruvianus*, distinguished from all the other species of *Coassus* by its large size, of which *Furcifer antisiensis*, Gray (Ann. & Mag. Nat. Hist. 1873, xii. p. 162, Hand-list of Ruminants, t. xxxv. figs. 1 & 2), will be a synonym. It is quite distinct from the *Coassus Whitelyi*, Gray (Ann. & Mag. Nat. Hist. 1873, xii. p. 163, Hand-list of Ruminants, t. xxxii. fig. 2), also from Peru.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 77. MAY 1874.

XLV.—*On* Duncanella, *a new Genus of Palæozoic Corals.*

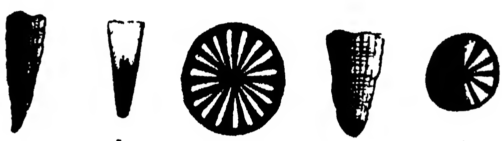
By H. Alleyne Nicholson, M.D., D.Sc., F.R.S.E., &c., Professor of Natural History in University College, Toronto.

My friend Mr. U. P. James, of Cincinnati, well known amongst American palæontologists by his 'Catalogue of the Lower Silurian Fossils of Ohio,' has recently placed in my hands several specimens of a curious little coral from the Niagara group of Indiana, which appears to me to form the type of a new genus, and which I propose to call *Duncanella*, in honour of Professor P. M. Duncan, one of the highest of living authorities on the fossil Actinozoa. The characters of the genus are as follows:—

Corallum simple, conical, free, and non-adherent. Calice deep, circular, very slightly expanded above. Septa included within the calice, apparently in multiples of six, extending to the centre of the theca. A columella wanting, or at any rate non-determinable. Epitheca well developed, with vertical and encircling striæ extending to the margin of the calice, but deficient at the base, where it leaves a circular aperture from which the septa protrude in the form of a small cone. No tabulæ or dissepiments.

The affinities of *Duncanella* would appear to be with the Turbinolidæ; but it cannot be placed under any recorded genus of this family, nor does it even show any decided relationship with any type of the Aporosa. I should have been

disposed to place these corals under the genus *Petraia* but for two facts. In the first place, the septa appear to be clearly arranged in multiples of six, being twelve at the base and eighteen in number at the calice; whilst, in the second place, there is the anomalous character that the extreme base of the corallum is destitute of an epitheca. The visceral chamber is thus open below as well as above, the inferior aperture being distinctly circumscribed, circular in form, and exposing to view the slightly exsert septa. At first sight I thought this aperture might perhaps be accidental; but it is present in all the specimens I have examined, with the exception of one large example, in which it appears to have been cicatrized, and is only obscurely and with difficulty recognizable. From the cyathophylloid corals *Duncanella* is



a b c d e

Duncanella borealis, Nich.: *a*, side view of an average specimen, of the natural size; *b*, vertical section, showing the very deep cylindroid calice; *c*, transverse section, enlarged; *d*, side view of the base, enlarged, showing the inferior aperture and slightly exsert septa; *e*, the base viewed from below, much enlarged, showing the absence of the epitheca and the septa meeting in a central point.

distinguished by not having the septa in multiples of four, and by the total absence of tabulæ or dissepiments. From *Cyathaxonia*, lastly, the present genus is distinguished by its want of a columella and septal fossette, the number of the septa, and the characters of the base.

The following is the only species of the genus that has come under my notice:—

Duncanella borealis (Nicholson).

Corallum simple, free, cylindro-conic, from 7 to 10 lines in length, and 2 lines in diameter at the calice. The base is truncated, destitute of an epitheca, and exhibiting a circular opening about half a line in diameter. Within this opening are seen twelve septa which extend from the circumference to the centre, and usually project slightly in the form of a little cone. The rest of the coral is covered with a well-developed epitheca, which exhibits well-marked longitudinal ridges, together with a few shallow annulations of growth, between

which are fine encircling striæ. The calice is extremely deep, occupying about one third of the total length of the corallum, cylindroid, and only slightly expanded towards its margin. Eighteen equally developed septa appear in transverse sections of the coral immediately below the bottom of the cup; and these meet in the centre of the visceral chamber, apparently without the intervention of any columella, though seemingly somewhat elevated centrally. There are no traces of either tabulæ or dissepiments, and the interseptal loculi appear to extend uninterruptedly from the base to the calice. Towards the margins of the calice the septa appear to become obsolete; but their free edges are unknown.

Locality and Formation.—Niagara Group (Upper Silurian), Indiana, U.S.A. Collected by Mr. U. P. James.

XLVI.—*On a new Genus of Carboniferous Polyzoa.* By Professor JOHN YOUNG, M.D., and Mr. JOHN YOUNG, Hunterian Museum, University of Glasgow.

[Plate XVI. B. figs. 1-6.]

AFTER a careful examination of the literature of *Ceriopora gracilis*, Phillips, sp., the only conclusion we can come to is that a polyzoon and a coral have been confused. With the coral we have not at present to do; but to make clear our position, we shall quote the generic and specific descriptions.

"CERIOPORA (pars), Goldfuss, 1826; Blainville, 1834; D'Orbigny, 1847.

"Colony fixed by the base, from which cylindrical dichotomous branches proceed, giving a dendroid aspect. Each branch is provided with several superposed layers, enveloping each other, the cells being simply round pores on the surface.

"Goldfuss, in 1826, placed under *Ceriopora* a multitude of diverse Bryozoa. In 1834 Blainville considerably restricted the characters of the genus, and only placed in it species provided with several layers of superposed cells, whether the colony is branching or bulbous. Now, in accordance with the plan we have adopted with all the Bryozoa, we think the name *Ceriopora* ought to be reserved more specially for the branching dendroid species, the globular non-dendroid species forming the genus *Reptomulticava*. Hence it will be necessary to change the names of several of the *Cerioporæ* admitted in 1847 into our 'Prodrome de Paléontologie Stratigraphique;'

for at that time we had not recognized the differences based on the presence of one or more layers of cells."—D'ORBIGNY, *Paléontologie Française*, v. p. 1029 (1850–52).

"CERIOPORA, nobis. (*Alveolitæ* species, Lam.)

"Polypary stony, sessile or affixed, composed of several concentric layers of cells enveloping each other; cellules tubular or subprismatic, subcontiguous, parallel or divergent." —GOLDFUSS, *Petrefacta Germaniæ*, p. 32.

At page 244 the polyp-cells of these corals are described as round short tubes which have neither transverse nor vertical lamellæ, neither a siphon nor lateral connecting tubules. They sometimes lie parallel and immediately in contact with each other, and press on each other so as to appear obscurely prismatic; sometimes they diverge. Their apertures are equal in diameter to the tubes, and are seldom constricted or dilated. The polypary enlarges by the concentric superposition of new layers. The branches of this mass are likewise made up of several layers.

Pictet ('Traité de Paléontologie,' 1857, iv. p. 154) places *Ceriopora* under the family Tubuliporides, tribe Foraminés—among those, therefore, which have the cells pierced in the common calcareous mass, and not salient. He considers this genus one which should rather be abolished than restricted. His definition is, "they form colonies composed of equal or nearly equal cells united by their margins, and not prolonged into tubes."

"CERIOPORA, Goldfuss.

"Polypidom tuberose, composed of numerous thin concentric layers; pores round, unequally placed.

"This genus was intended by Goldfuss to include several fossil forms now referred to *Alveolites*, *Chrysaora*, &c. The above definition is of the genus as now restricted."—M'COY, *Palæozoic Fossils*, p. 194.

"*Millepora.*—Pores very minute, perpendicular to the surface; cells without lamellæ."—*Ibid.* p. 195.

Phillips places *Millepora*, along with *Fenestella*, *Glauconome*, &c., among the Polypiaria, along with *Favosites* and the other true corals.

Morris ('Catalogue of British Fossils,' edit. 1854) puts *Ceriopora*, Goldfuss, 1826, in the Bryozoa, and gives *C. gracilis* and *C. interporosa* under that generic heading, *Millepora* being among the Zoophytes.

Amid this confusion it is apparent that Pictet's suggestion

to set aside *Ceriopora* has much to commend it; for the confusion of Corals and Bryozoa commenced with Goldfuss. His definition, therefore, is not precise enough, though it is obvious that he founded the genus on a coral. M'Coy's restricted genus also belongs to the Corals; while Morris, by his transfer of the name *Ceriopora* to a Bryozoon, has left the species under consideration without a generic name to which it has a legitimate title. This question of nomenclature is one of great difficulty; as, however, the essential character of the fossil we are about to describe separates it from all other known Carboniferous forms, we would suggest *Rhabdomeson* as the generic name, the axis being central, not lateral as in Allman's *Rhabdopleura.*

Rhabdomeson gracile (nov. gen.).

Millepora gracilis, Phillips, Pal. Foss.
Ceriopora gracilis, Morris, Catalogue.

The stem is slender, cylindrical, branching, the branches coming off at right angles to the stem and never less than an inch apart, and consists of a hollow axis formed by a thin calcareous tube, and of a series of cells ranged round the axis. There are 100 cell-apertures in a linear inch; the apertures are oval, with simple outlines, the funnel-shaped depressions at the bottom of which they are placed sloping down from the crests of the dividing ridges. These ridges are tuberculated, a large tubercle, which well-preserved specimens show to be a blunt spine, being placed at the upper and lower angles of each aperture. Hence the periphery of a single cell usually presents four such tubercles, while smaller tubercles occur between each larger pair. But the aperture of the cell does not occupy the whole area of the pore-depression; a thin lamina reduces the orifice, hymen-like, to one fourth of the area of the pit; and this restricted orifice is at the upper end of the depression (Pl. XVI. B. fig. 4). The cells are conical, the inner extremity being in contact with the axis, the cell turning upwards and outwards so that the plane of its aperture is parallel to the axis. The apex of the curved cone terminates two cells and a half below its orifice. Towards their apices the cells are separated by a very thin common wall, which thickens outwards so that the orifices are separated by a partition whose thickness is one third of the diameter of the cell-cavity at its widest part. When the cells have been removed so as to expose the hollow axis, the wall of the latter is seen to be marked by minute round spots, which at first suggested the possibility of a communication existing between the cavity of the cell and that of

the axis. But careful examination has satisfied us that not merely is the cylinder imperforate, but the cones do not even abut on it; they run out alongside of it. Both axis and cells are filled sometimes with amorphous calcareous matter or with clay sediments. In the latter case the casts obtained by dissolving away the skeleton with acid (fig. 3) show a notch on the lower side of their widest part corresponding to the thin lamina already mentioned, while the mass lying beyond the notch is the mass of sediment that filled up the pit or vestibule already described. There is no trace of septa in the cell or in the axis; there are no tubules putting adjacent cells in communication; and there is no sign of avicularia or other external processes. The spines are solid; but the worn ones show something like a central pit. We have not found the free ends of any of the branches; but the equality of all the cells forbids the supposition that they are multiplied by intercalation. The central tubular axis has a thin wall, which is distinct from that of the cells in contact with it (fig. 6). In fact, the line of separation between these calcareous layers is everywhere recognizable, and is prolonged into the tubercle or spine (fig. 6, *c*). The bounding ridge and tubercle are, in fact, shared by adjacent cells, and the calcareous matter is deposited in laminæ, as shown roughly in figs. 4, 5, & 6, whereas the walls of the cells as far as the oral lamella are homogeneous. We have not ascertained what is the condition of the calcareous matter in these layers, our chief object being to show that a central pit in these, as in other similar structures, neither implies a central canal nor an articulated appendage. Each cell has, in short, its own proper wall. The cells are throughout equal or nearly so—the differences seen in fig. 2 being of very rare occurrence, though when they exist the regularity of the quincunx is impaired. But the equality is such as to forbid the idea that the cells are intercalated, an important point in the definition of *Ceriopora*.

Assuming the hydroid character of the Graptolites, *Rhabdopleura* is the only polyzoon hitherto known in which a solid axis is found; and in it the cells terminate the nodes of the axis. The form just described rather resembles a sclerobasic coral in having the axis wholly within the circlet of cells. What may be the true affinities of *Rhabdomeson*, it would be rash on our part to attempt to determine. The novelty of the type has induced us to publish it at once, reserving the generic definition till we complete our investigations into other species referred erroneously to *Ceriopora*. We should be glad if collectors who may possess forms similar to that here figured would lend us specimens for comparison—and would suggest the

propriety of a reexamination of *Websteria crisioides*, Edw. & Haime, the description having some points of resemblance to that of *Rhabdomeson*.

Distribution.—*Rhabdomeson* (*Ceriopora*) *gracile* is common in all the limestones and shales which yield Polyzoa throughout the west of Scotland. It ranges from the lower to the upper members of the Carboniferous Limestone. In some of the harder shales specimens occur two or three inches in length; while by washing the soft and weathered shales, numerous well preserved fragments are easily obtained. In some localities it is associated with species of *Ceriopora*, viz. *C. interporosa*, Phill., *C. rhombifera*, Phill., and *C. similis*, Phill.; while in other localities it is the only species met with. The white limestone of Trearne, near Beith, Ayrshire, has yielded numerous natural sections. The stone splits in most cases parallel with the axis of the stem, and shows the central hollow tube, bare of cells for considerable lengths. The tube in these specimens never shows more than a fine layer of minute crystals of calcite lining its interior. Those from other localities have the tube more or less filled with amorphous calcite or clay, or both. If the identification with Phillips's species is correct, this species descends to the Pilton group.

EXPLANATION OF PLATE XVI. B. figs. 1–6.

Fig. 1. *Rhabdomeson gracile* (nov. gen.). Fragment, natural size. This and the other figures, except fig. 4, were drawn with the camera lucida.

Fig. 2. Ditto, enlarged, to show character of tubercles.

Fig. 3. Ditto, polished and slightly etched with acid, to show the mesial axis, *d*, and casts of cells: *a* and *c* show casts which reach the surface in the plane of section; the notch in the lower surface of each cast shows the position of the oral lamella, the matter external to the notch being matrix, which fills up the vestibule shown in fig. 2. Opposite *b*, a fragment of a cell is seen lying on the axis; and at *e* the apices of several cells are seen surrounding the axis.

Fig. 4. Ditto. Diagram of cell, to show conical form, position of lamella, and shape of vestibule.

Fig. 5. Ditto. Transverse section, showing hollow axis and surrounding cells cut across at various points, and the angular form caused by mutual pressure.

Fig. 6. Ditto. Two tubercles, greatly enlarged to show structure, as seen by transmitted light; *a*, cell-aperture; *b*, central axis; *c*, *c'*, tubercles.

XLVII.—*A Concise Notice of Observations on certain Peculiarities in the Structure and Functions of the* Araneidea. By John Blackwall, F.L.S.

Much diversity of opinion being entertained by eminent zootomists and physiologists with regard to the structure and function of certain organs common to spiders belonging to several genera, which are situated near the extremity of the inferior surface of the abdomen, immediately before the spinning-mammulæ, I availed myself of recent visits of a friend, Mr. William Statham, to inspect under his excellent binocular microscope the parts in question, carefully prepared for the purpose by himself. When efficiently illuminated and viewed with a magnifying-power of about 125 diameters, they were distinctly perceived to be provided with very numerous and exceedingly delicate spinning-tubes, completely establishing the accuracy of the conclusion at which I had previously arrived by minute investigation, namely that the parts constitute an additional or fourth pair of spinners united throughout their entire length*.

The spiders submitted to examination were *Ciniflo atrox*, *C. similis*, and *Ergatis viridissima*. Between the proximate extremities of the fourth pair of spinners in the first two species there is a distinct septum; but in *Ergatis viridissima*, *Mithras paradoxus*, and some other small spiders provided with the additional spinners no septum is apparent, the entire area formed by their contiguous extremities being amply supplied with spinning-tubes.

The conjoined spinners composing the fourth pair are movable, and, when in action, present their extremities to the calamistra, which in passing over them draw out and card the excessively fine filaments proceeding from the spinning-tubes into the two delicate pale blue bands that enter into the composition of every flocculus in the complex snares of *Ciniflo atrox*, *C. similis*, and *C. ferox*.

The small spiders, the proximate extremities of whose additional spinners are without any definite mark of distinction, have the calamistrum (situated upon a ridge on the abdominal side of the upper surface of the metatarsal joint of each posterior leg) usually composed of a single row of curved movable bristles; but the calamistrum of the larger species of *Ciniflo* commonly consists of two parallel rows of fine spines.

I may here remark that the calamistra are frequently much

* Transactions of the Linnean Society of London, vol. xviii. p. 228 et seq.

less conspicuous on male than on female spiders, the occasions for their employment being fewer and of minor importance in the former than in the latter sex.

The prevalent opinion, that the very remarkable snare of *Mithras paradoxus* does not afford any evidence in its construction of the action of the fourth pair of spinners and the calamistra with which this spider is provided, is probably erroneous; for I have reason to believe that the transverse lines attached to the four radii in the snare of this species are formed by the agency of the calamistra in passing over the extremities of its spinners; and this agency is undoubtedly exercised in forming the external convex covering of its cocoon. A species of *Mithras* which inhabits the United States of North America evidently employs its fourth pair of spinners and calamistra in the fabrication of its cell.

Now, as I am disposed to attach much importance to the habits and economy of spiders with reference to their systematic arrangement, the fact that species provided with calamistra are always found to possess the additional spinners, and that these parts constantly cooperate to produce results affecting their economy in a very obvious manner, has not, I apprehend, had that consideration bestowed upon it by arachnologists to which it appears to be entitled.

The late Mr. Richard Beck communicated to the Microscopical Society of London, in the year 1861, some remarks on the formation of the viscid spiral line in the snare of *Epeïra diadema*, commonly denominated the garden spider. In this paper, of which I have merely seen an abstract, the following statement occurs:—"With only a pocket-lens I could distinctly see that the viscid lines, as first drawn from the abdomen, were not dotted. On a careful examination with the microscope, the thread at first appeared only slightly thicker than an ungummed line; but after a very short time undulations appeared, and subsequently, at the most regular distances, the viscid matter formed into alternating large and small globules. The whole process is a beautiful illustration of molecular attraction."

Without questioning the accuracy of Mr. Beck's observations, several difficulties present themselves in connexion with his explanation of this curious subject, that carefully conducted investigation alone can dispel. To some of these difficulties I shall now direct attention.

The fine elastic line on which the viscid globules are distributed is *consolidated*; but it is perplexing even to conjecture how this consolidation is effected, since, according to Mr. Beck, the line is surrounded by a viscid fluid as it is drawn from the

abdomen; the importance, therefore, of ascertaining by close inspection whether the line and the viscid fluid in which it is enveloped proceed from the same spinning-tube or not will be immediately apparent. It is evident, from the materials of which they are composed possessing such widely different properties, that they cannot be produced by the same organ of secretion.

There is a difficulty also in comprehending how a cylindrical body of *viscid* fluid can be resolved by molecular attraction into a series of large and small globules disposed on the line *alternately* at minute and most regular distances from one another.

Had Mr. Beck been spared to continue his researches, he might perhaps have been enabled, by his well-known skill as a microscopist and by the advantage he possessed in having superior optical instruments at his command, to throw some light on the obscure phenomena here submitted to the consideration of arachnologists, which remain as problems yet waiting a solution.

XLVIII.—*On the Invertebrate Marine Fauna and Fishes of St. Andrews.* By W. C. M'Intosh.

[Continued from p. 315.]

Section II. MOLLUSCA (PROPER).

The Mollusca are chiefly procured by dredging, examination between tide-marks, or the deep-sea lines of the fishermen, though certain storms sometimes strew the sands with many species in great profusion. Not a few of the rarer forms are found in the stomachs of fishes, such as the cod, haddock, and flounder. The remarks on the class may be arranged in three divisions, founded on the economical value, peculiar habits, and rarity.

By far the most important species in the first group is the common mussel (*Mytilus edulis*), which occurs in vast numbers in the form of mussel-" beds " on muddy flats, chiefly situated on the right bank of the estuary of the river Eden. Attached to stones, sticks, and to each other, these shell-fish luxuriate in abundance of Diatomaceæ, Infusoria, and other minute forms of animal and vegetable life. From their special value as bait the city derives a considerable annual revenue; and if the wise protection only lately enforced were supplemented by

skilful mussel-farming, great increase in revenue might be anticipated. Shell-fish, like other animals in civilized parts, cannot survive constant inroads without special restrictions. Multitudes of the young mollusks, moreover, are found incrusting the poles for the salmon-nets on the West Sands, and the rocks, stones, and tangle-roots elsewhere; but they do not attain a large size, apparently from overcrowding and the want of congenial food, which the purer water seems incapable of supplying. This species takes the place of the horse-mussel ("yoags") of the Zetlandic fishermen, and the worms of those in the Channel Islands. It is seldom eaten by the natives. The edible cockles, again, abound on the sandy flats near the entrance of the Eden into the sea, and are occasionally sold as food, though of late years their scarcity has rendered their appearance less frequent in the market. Periwinkles and limpets are constantly gathered for similar purposes. The only uses to which some of the other mollusks are applied are in the amateur manufacture of ornaments, such as shell pincushions from various univalves and bivalves, bracelets from *Nassa incrassata* and *Trochus cinerarius*, after the latter has had its nacreous layer exposed by an acid.

The rock-boring shell-fish are five in number, though only one exercises any great influence on the disintegration of the rocks—viz. *Pholas crispata*, which often swarms in the shale and sandstone, and takes the place of the *Pholas dactylus* of the chalk rocks of the south. *Pholas candida* occurs too rarely to require special mention in this respect; and the same may be said of *Saxicava rugosa*. The excavations of *Patella vulgata* and *Chiton fascicularis* in sandstone show that no special boring-organ is necessary for this purpose. The latter species sometimes scoops out considerable cavities in sandstone, in which it reposes. The only wood-borer is *Xylophaga dorsalis*.

In taking, under this head, a general survey of the boring forms, it is found that they belong to at least three invertebrate subkingdoms, viz. the Protozoa, Mollusca, and Annulosa. In the first are boring sponges; in the second, Bryozoa and various mollusks; in the third, sea-urchins, gephyreans, annelids, and cirripedes.

The sponges appear to bore only into calcareous substances, such as shells and limestone. The Bryozoa perforate shells; the mollusks proper, limestone, sandstone, aluminous shale, gneiss and other rocks, wood, wax, shells, &c.; the annelids tunnel shells and rocks of various kinds; the sea-urchins calcareous rocks, gneiss, granite, and other rocks; the gephyreans and cirripedes shells and limestone. Good opportunities are afforded at St. Andrews for studying the boring-action of the

mollusks and annelids. *Pholas crispata* and *Leucodore ciliata* are equally abundant, and must exercise as much influence on the disintegration of the sandstone and shale between tide-marks as the boring sponges amongst the shells in deep water; while *Patella*, *Chiton*, *Saxicava*, and *Dodecaceria* are also frequent.

The theories which have been promulgated to explain the mode by which these various creatures perforate materials so diverse may be ranged round two great centres, viz. the *chemical* and the *mechanical* *. The advocates of the former seem to take for granted that the borings occur chiefly in calcareous substances; and with propriety, therefore, they make their solvent an acid. It is clear, however, that this agency is unable to account for the abundant perforations in media totally impervious to such action. Moreover no trace of acid is found in many borers; and though present in some, as in *Sabella saxicava* and *Pholas*, it is likewise characteristic of other marine animals which do not bore; and it is purely hypothetical at present to bring in the aid of the carbonic dioxide derived from sea-water, for the same reason.

The mechanical theory, again, supposes that the animals perforate by means of shells or gritty particles in the case of mollusks, teeth in the sea-urchins, bristles in the annelids, horny processes in certain cirripedes and gephyreans; but we are left in doubt concerning the extensive and wonderful perforations of the sponges, those of the Bryozoa, and the rest of the cirripedes. If, however, we regard the "macerating" theory as a modification of this, certain of the difficulties will be overcome. The grains of wood, however, found in the stomachs of *Teredo*, are interesting in this respect.

The whole subject of the boring of marine animals, indeed, is much in want of further elucidation; and it is hard to believe that the same *modus operandi* exists in all. In conclusion, the theories may be arranged under the following heads (for all the subkingdoms), after Forbes and Hanley and Gwyn Jeffreys:—

I. That in the shell-fish the perforations are made by rotations of the valves, like augers (Bonanni, Adanson, Born, J. E. Gray, Dr. Fleming, Osler, Forbes and Hanley, Cailliaud, Robertson, &c.); in the sea-urchins, by the teeth (Cailliaud).

This theory is not supported by an examination of the perforations of the sponges, Bryozoa, those of the annelids,

* We do not here allude to the boring by jaws or tongue (*e. g.* in *Limnoria* and *Trochus*).

gephyreans, and cirripedes, nor by a comparison of the shells and tunnels of the mollusks themselves. The epidermis of the latter in each case would likewise suffer.

II. That the holes are made by rasping effected by siliceous particles on the foot of the mollusk (Hancock), by grains of silex from the exterior (Bryson), by the foot in some way (Dr. Fischer), and by chitine in the cirripedes (Darwin) and gephyreans and the bristles of the annelids.

This explanation is not borne out by the case of the sponges, by that of the Bryozoa, and certain cirripedes; moreover such siliceous particles are rare in boring mollusks.

III. That the excavations are due to ciliary currents, aided by rasping (Garner).

The currents may assist, but seem to be insufficient to account for the borings in any group.

IV. That the perforations are produced by a chemical solvent: Gray, Osler (for *Saxicava*), Drummond, Cailliaud, Mantell, Thorent, Reeve, Bouchard-Chantereaux, Spence Bate, Darwin (for *Verruca*), E. R. Lankester, and Parfitt.

This will not explain the borings in wood, aluminous shale, gneiss, granite, sandstone, and wax. It is interesting, however, as my friend Mr. Ray Lankester has specially shown, that shells and calcareous rocks are much affected by burrowing marine animals.

V. That the borings are the result of a secreted solvent and rasping action (Thompson and Necker).

It seems improbable that the solvent should vary with the nature of the rocks attacked.

VI. That the perforations are caused by a macerating or simple solvent action of the foot in mollusks (Sellius, Deshayes, and Gwyn Jeffreys).

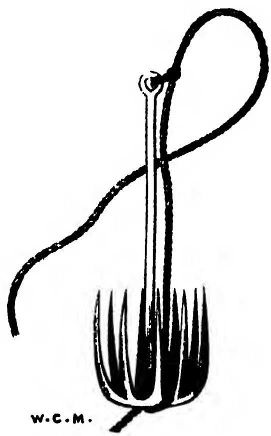
It is doubtful if this would be supported by the action in the sponges, Bryozoa, annelids, gephyreans, and cirripedes. The striæ in certain of the tunnels of the shell-fish are also somewhat at variance with this notion.

The most interesting species in regard to rarity are *Lima subauriculata* and *L. Loscombii*, which come from deep water, the characteristic *Lima hians* of our southern and western shores being absent. A worn valve of *Isocardia cor* found on the West Sands is purely accidental. *Tellina pusilla* and *Psammobia tellinella* are uncommon at St. Andrews. Amongst univalves, *Trichotropis borealis*, *Pleurotoma Trevelyana*,

Aplysia punctata, and *Philine pruinosa* are noteworthy. The smaller univalves, such as *Rissoæ* and their allies, are much less numerous in species than on the southern and western shores, the absence of *Trochus umbilicatus* being especially diagnostic when contrasted with the latter. The Nudibranchs are well represented at all seasons; and the individuals in the majority of the species are numerous. *Ommatostrephes* and *Loligo* amongst the cuttles often occur in great profusion on the West Sands after storms.

On the whole the species are northern, and stand in strong contrast to the molluscan fauna of the western shores, where *Thracia convexa*, *Tapes decussatus*, *Pecten varius*, var. *nivea*, *Teredo megotara* and *T. norvegica*, *Fissurella*, *Trochus umbilicatus* and *T. zizyphinus* in the littoral zone, and the abundance of *T. magus* and *T. tumidus* in the laminarian, *Phasianella*, *Akera bullata*, *Elysia*, swarms of large and small *Rissoæ*, and the pelagic *Ianthina* form conspicuous features of the marine fauna, just as the hosts of *Bulimus acutus* do on the sandy fields of Killipheder and other parts of the extreme west. Still more evident is the contrast with the rich southern species that cluster round the Channel Islands—such as the finely developed pectens, oysters, and *Anomiæ*, and the appearance of the former between tide-marks (*P. varius*), besides *Mytilus barbatus* (which takes the place of the bearded varieties of our *Mytilus modiolus*) in obscure crevices in the littoral zone, the frequency of *Arca tetragona* in fissures of the rocks, *Galeomma* on the under surface of stones in tide-pools at Herm, the boring *Gastrochæna* in shells, and the abundance of *Haliotis*, *Pandora*, *Venus verrucosa* and *V. ovata*, *Mactra glauca*, the *Psammobiæ*, and the "angel's wings" (*Lima*), which when disturbed flit with their brilliant orange fringes so nimbly in the tide-pools. Amongst univalves, again, the large size and abundance of *Chiton discrepans*, *Fissurella*, *Emarginula*, *Murex erinaceus*, *Aplysia punctata*, *Eulima polita*, *Trochus lineatus*, *Cerithium* and *Cerithiopsis*, and the predatory and cunning cuttles (*Octopus*) between tide-marks are noteworthy; while in the surrounding water are the rare prizes *Triton nodifer*, *T. cutaceus*, *Cardium papillosum*, *Argiope decollata*, and other forms which, with the foregoing, are thrown in such profusion on the shell-beach at Herm—e. g. *Calyptræa chinensis*, *Trochus Montacuti*, and *Murex aciculatus*. The fine *Pinna rudis* of South England is also entirely absent at St. Andrews. Neither do we find the swarms of *Trochus helicinus* and *T. grœnlandicus*, *Trichotropis borealis*, and their allies amongst the tangle-roots, as in Shetland, nor the *Terebratulæ*, *Lyonsia*, *Lepeta*, *Puncturella*, *Trochus amabilis*, the *Jeffreysiæ*, *Columbella haliæeti*, *Pleurotoma nivalis*, *P. carinata*, *Scaphander librarius*,

Philine angulata and *P. nitida*, *Rossia papillifera*, the Clios, and the half hundred new British forms discovered by Mr. Gwyn Jeffreys in his frequent cruises in the surrounding waters. The great beds, also, of *Mytilus modiolus* (called "yoags"), which occur in from 3 to 15 fathoms near the shore in many parts of the Zetlandic seas, present an interesting contrast. It is this mussel (esteemed but a coarse bait at St. Andrews) which is extensively employed by the Shetlanders; and in its collection many rare invertebrates are found amongst the roots of the tangles and stones, which with the mussels form huge muddy masses. The old ten-toothed "dreg" noticed by the accomplished Prof. Edward Forbes is still the chief instrument in procuring the shell-fish, and is much more serviceable to the zoologist on such ground than the dredge. In the figure given by the facile pencil of the great naturalist the rope is attached to the eye of the dreg; but in modern times the fishermen more correctly attach it to the head of the instrument (after the manner of the ordinary dredge), and fix the rope at the eye of the dreg by a piece of spun yarn; so that if the dreg gets entangled the spun yarn gives way, and the rope pulls the head of the dreg backwards, and disengages the teeth from the tangles and stones. In transverse section the teeth form a truncated ellipse round the central iron rod.



The nomenclature adopted is that of Mr. Gwyn Jeffreys in his valuable work on the British Mollusca; and I am specially indebted to him for his great courtesy in frequently aiding me in doubtful cases, and also carefully investigating shell-débris containing minute species, which otherwise might have been overlooked.

Class CONCHIFERA.

Order Lamellibranchiata.

Fam. 1. **Anomiidæ**, Gray.

Genus Anomia, L.

Anomia ephippium, L. Jeffreys, Brit. Moll. ii. p. 31, v. pl. 20. f. 1, 1 *a*–1 *e*.

Not uncommon in the débris of the fishing-boats.

Anomia patelliformis, L. *Op. cit.* ii. p. 34, v. pl. 20. f. 2, 2 *a*–2 *c*.

Common in the same region, as well as between tide-marks

Fam. 2. **Ostreidæ**, Broderip.

Genus Ostrea, L.

Ostrea edulis, L. *Op. cit.* ii. p. 38, v. pl. 21.

Living examples are rare. The "rock" variety with purplish streaks, however, is occasionally found at the East Rocks on the under surface of stones in pools near low water.

Fam. 3. **Pectinidæ**, Lamarck.

Genus 1. Pecten, Pliny.

Pecten pusio, L. *Op. cit.* ii. p. 51, v. pl. 22. f. 1 & 1 *a*.

Common; the living specimens come from the deep water of the bay, chiefly attached to bivalves. Worn valves are abundant in the gravel at the East Rocks.

Pecten opercularis, L. *Op. cit.* ii. p. 59, v. pl. 22. f. 3 & 3 *a*.

Frequently brought by the fishing-boats, and thrown on the beach after storms.

Pecten tigrinus, O. F. Müller. *Op. cit.* ii. p. 65, v. pl. 23. f. 2 & 2 *a*.

Perfect specimens from the coralline ground and the stomachs of haddocks and flounders; single valves on the beach in gravel and after storms.

Pecten similis, Laskey. *Op. cit.* ii. p. 71, v. pl. 23. f. 5.

Frequent in the stomachs of flounders and haddocks; more rarely procured from the coralline ground.

Pecten maximus, L. *Op. cit.* ii. p. 73, v. pl. 24.

Occasionally brought up on the deep-sea lines of the fishermen.

Genus 2. Lima, Bruguière.

Lima subauriculata, Mont. *Op. cit.* ii. p. 82, v. pl. 25. f. 3.

Not common; from the deep water of the bay.

Lima Loscombii, G. B. Sowerby. *Op. cit.* ii. p. 85, v. pl. 25. f. 4.

Single valves occasionally appear in the fishing-boats; perfect specimens are found in the stomach of the cod.

Fam. 5. **Mytilidæ**, Fleming.

Genus 1. Mytilus, L.

Mytilus edulis, L. *Op. cit.* ii. p. 104, v. pl. 27. f. 1.

Forming by their vast numbers a most important mussel-bed at the estuary of the river Eden. Multitudes of the young animals, besides, form a coating to the posts of the salmon-nets, to rocks, stones, and tangle-roots in various places.

Mytilus modiolus, L. *Op. cit.* ii. p. 111, v. pl. 27. f. 2.

Frequently thrown ashore after storms, and brought by the fishermen from deep water. Monstrosities and varieties are common; and there is no shell so prolific in parasitic or commensalistic growths; pea-crabs and pearls are common in their interior. Young forms (bearded) occur in chinks of the rocks between tide-marks.

Genus 2. Modiolaria, Beck.

Modiolaria marmorata, Forbes. *Op. cit.* ii. p. 122, v. pl. 28. f. 1.

Abundant in the tests of *Ascidia sordida*, and sometimes found in a free condition on the West Sands after storms.

Modiolaria discors, L. *Op. cit.* ii. p. 126, v. pl. 28. f. 3.

Occasionally attached to the roots of Fuci near low water, and to the top-shaped fronds of *Himanthalia lorea*.

Modiolaria nigra, Gray. *Op. cit.* ii. p. 128, v. pl. 28. f. 4.

Fine specimens occur in the deep water of the bay, and also in the stomachs of cod.

Genus 3. Crenella, Brown.

Crenella decussata, Montagu. *Op. cit.* ii. p. 133, v. pl. 28. f. 6.

Not rare in the stomachs of cod and haddocks, though perhaps swallowed in the first instance by other fishes.

Fam. 6. **Arcidæ**, Lowe.

Genus 1. Nucula, Lamarck.

Nucula nucleus, L. *Op. cit.* ii. p. 143, v. pl. 29. f. 2.

Common in the bay; brought in by the fishing-boats, and frequent in the stomachs of cod and haddocks.

Nucula nitida, G. B. Sowerby. *Op. cit.* ii. p. 149, v. pl. 29. f. 3 & 3 *a*.

Not rare off the East Rocks in sandy gravel between the rocky ridges, and in the stomachs of haddocks and cod.

Nucula tenuis, Mont. *Op. cit.* ii. p. 151, v. pl. 29. f. 4.

From deep water and the stomachs of cod and haddocks.

Genus 2. Leda, Schumacher.

Leda minuta, Müller. *Op. cit.* ii. p. 155, v. pl. 29. f. 6.

Common in deep water and the stomachs of flounders.

Genus 4. Pectunculus, Lamarck.

Pectunculus glycymeris, L. *Op. cit.* ii. p. 166, v. pl. 30. f. 2.

Abundant in the bay; generally brought in by the fishing-boats.

Genus 5. Arca, L.

Arca tetragona, Poli. *Op. cit.* ii. p. 180, v. pl. 30. f. 6.

Instead of the clusters in which it appears in the chinks of the rocks in the Channel Islands, solitary examples only are dredged off the bay in deep water.

Fam. 8. **Kelliidæ**, Forbes & Hanley.

Genus 2. Montacuta, Turton.

Montacuta bidentata, Mont. *Op. cit.* ii. p. 208, v. pl. 31. f. 8.

Abundant in shell-débris on the West Sands.

Montacuta ferruginosa, Mont. *Op. cit.* ii. p. 210, v. pl. 31. f. 9.

Common in the deep water of the bay and in the stomachs of cod, haddocks, and flounders; also in the shell-débris on the West Sands after storms.

Genus 3. LASÆA, Leach.

Lasæa rubra, Mont. *Op. cit.* ii. p. 219, v. pl. 32. f. 1.

Abundant amongst algæ, in crevices under stones in rock-pools, and in the cavities of shells between tide-marks.

Genus 4. KELLIA, Turton.

Kellia suborbicularis, Mont. *Op. cit.* ii. p. 225, v. pl. 32. f. 2.

Common under stones in rock-pools, and in the cavities of old limpet- and other shells.

Fam. 9. **Lucinidæ**, D'Orbigny.

Genus 2. LUCINA, Bruguière.

Lucina borealis, L. *Op. cit.* ii. p. 242, v. pl. 32. f. 7.

Frequently brought in by the fishing-boats, though the majority of the specimens are imperfect (single valves).

Genus 3. AXINUS, J. Sowerby.

Axinus flexuosus, Mont. *Op. cit.* ii. p. 247, v. pl. 33. f. 1.

Single valves occasionally from the fishing-boats, and on the West Sands after storms.

Fam. 10. **Carditidæ**, Gray.

Genus CYAMIUM, Philippi.

Cyamium minutum, Fabricius. *Op. cit.* ii. p. 260, v. pl. 33. f. 5.

Common in shell-débris on the West Sands.

Fam. 11. **Cardiidæ**, Broderip.

Genus CARDIUM, L.

Cardium echinatum, L. *Op. cit.* ii. p. 270, v. pl. 34. f. 2.

Very abundant on the West Sands after storms, and in the débris of the fishing-boats.

Cardium fasciatum, Mont. *Op. cit.* ii. p. 281, v. pl. 35. f. 3.

Not uncommon on the West Sands after storms, and in the stomachs of cod, haddocks, and flounders.

Cardium nodosum, Turton. *Op. cit.* ii. p. 283, v. pl. 35. f. 4.
Dead valves occasionally dredged off the East Rocks in 3 to 4 fathoms.

Cardium edule, L. *Op. cit.* ii. p. 286, v. pl. 35. f. 5.
Abundant in the muddy sand at the mouth of the river Eden. Cockle-gathering forms the occupation of some of the fisherwomen.

Cardium norvegicum, Spengler. *Op. cit.* ii. p. 294, v. pl. 35. f. 7.
Not uncommon; generally brought by the fishermen from deep water.

Fam. 12. **Cyprinidæ**, Geinitz.

Genus 2. CYPRINA, Lamk.

Cyprina islandica, L. *Op. cit.* ii. p. 304, v. pl. 36. f. 2.
Common in deep water, and thrown ashore after storms. Some have rows of small adherent pearls.

Genus 3. ASTARTE, J. Sowerby.

Astarte sulcata, Da Costa. *Op. cit.* ii. p. 311, v. pl. 37. f. 1 & 2.
Frequently brought up by the deep-sea lines of the fishermen. Semifossil valves of *A. borealis* are also not uncommon.

Astarte compressa, Mont. *Op. cit.* ii. p. 315, v. pl. 37. f. 3 & 4.
Frequent in deep water.

Genus 4. CIRCE, Schumacher.

Circe minima, Mont. *Op. cit.* ii. p. 322, v. pl. 37. f. 6.
Not uncommon in deep water, and in the stomachs of cod, haddocks, and flounders.

Fam. 13. **Veneridæ**, Leach.

Genus 1. VENUS, L.

Venus exoleta, L. *Op. cit.* ii. p. 327, v. pl. 38. f. 1.
Abundant in deep water, and on the beach after storms.

Venus lincta, Pulteney. *Op. cit.* ii. p. 330, v. pl. 38. f. 2.
Common in deep water, and thrown plentifully on the West Sands after storms.

Venus fasciata, Da Costa. *Op. cit.* ii. p. 334, v. pl. 38. f. 4.

In 3 to 4 fathoms off the East Rocks, and from the deep-sea lines of the fishermen. Dead valves are common amongst the gravel at the East Rocks.

Venus casina, L. *Op. cit.* ii. p. 337, v. pl. 38. f. 5.

Occasionally procured in a perfect state from the deep-sea lines of the fishermen. Single valves are most abundant.

Venus ovata, Pennant. *Op. cit.* ii. p. 342, v. pl. 39. f. 1.

Common in deep water; generally procured from the fishing-boats.

Venus gallina, L. *Op. cit.* ii. p. 344, v. pl. 39. f. 2 & 3.

Abundant on the West Sands after storms, and in a few fathoms water on a sandy bottom all round.

Genus 2. TAPES, Mühlfeldt.

Tapes virgineus, L. *Op. cit.* ii. p. 352, v. pl. 39. f. 5.

Common in deep water and in the fishing-boats.

Tapes pullastra, Mont. *Op. cit.* ii. p. 355, v. pl. 39. f. 6.

Abundant between tide-marks amongst the muddy sand, and occasionally in cavities bored by *Pholas crispata.*

Genus 3. LUCINOPSIS, Forbes & Hanley.

Lucinopsis undata, Pennant. *Op. cit.* ii. p. 363, v. pl. 40. f. 1.

Common on the sandy ground, and thrown in vast numbers on the West Sands after storms.

Fam. 14. **Tellinidæ**, Latreille.

Genus 2. TELLINA, L.

Tellina crassa, Gmelin. *Op. cit.* ii. p. 373, v. pl. 40. f. 4.

Single valves of good size are not uncommon in the débris of the fishing-boats.

Tellina balthica, L. *Op. cit.* ii. p. 375, v. pl. 40. f. 5.

Abundant on the sandy beach at the mouths of the Eden and Tay, and on the West Sands after storms.

Tellina tenuis, Da Costa. *Op. cit.* ii. p. 379, v. pl. 41. f. 1.

Very common on the sandy ground everywhere; and dead valves occur on the West Sands throughout the year.

Tellina fabula, Gronovius. *Op. cit.* ii. p. 382, v. pl. 41. f. 2.

Only less common than the last species on the same ground.

Tellina pusilla, Philippi. *Op. cit.* ii. p. 388, v. pl. 41. f. 5.

Rather frequent in deep water, and in the stomachs of haddocks and flounders.

Genus 3. PSAMMOBIA, Lamarck.

Psammobia tellinella, Lamk. *Op. cit.* ii. p. 392, v. pl. 42. f. 1.

Worn valves occasionally found amongst the deep-sea lines of the fishermen.

Psammobia ferröensis, Chemnitz. *Op. cit.* ii. p. 396, v. p. 187, pl. 42. f. 3.

Abundant and in fine condition on a sandy bottom off the West Sands. Often thrown ashore in large numbers near the estuary of the Eden.

Genus 4. DONAX, L.

Donax vittatus, Da Costa. *Op. cit.* ii. p. 402, v. pl. 42. f. 5.

Very abundant on the West Sands after storms, and on sandy ground in a few fathoms.

Fam. 15. **Mactridæ**, Fleming.

Genus 2. MACTRA, L.

Mactra solida, L. *Op. cit.* ii. p. 415, v. pl. 43. f. 2.

Abundant on the sandy ground off the West Sands, and thrown in great numbers on the beach after storms.

Var. *elliptica* is common.

Mactra subtruncata, Da Costa. *Op. cit.* ii. p. 419, v. pl. 43. f. 3.

Equally common with the last species, and from the same ground.

Mactra stultorum, L. *Op. cit.* ii. p. 422, v. pl. 43. f. 4.

Very abundant on the same ground as the last two species.

Var. *cinerea* is common.

Genus 3. LUTRARIA, Lamarck.

Lutraria elliptica, Lamk. *Op. cit.* ii. p. 428, v. pl. 44. f. 1.

Common on the West Sands after storms, and in muddy sand at the mouth of the river Eden.

Genus 4. SCROBICULARIA, Schumacher.

Scrobicularia prismatica, Mont. *Op. cit.* ii. p. 435, v. pl. 45. f. 1.

Not rare in deep water; on the West Sands after storms, and in the stomachs of cod and haddocks.

Scrobicularia alba, Müller. *Op. cit.* ii. p. 438, v. pl. 45. f. 3.

Less common than the foregoing, from the same ground, and in the stomachs of the same fishes.

Scrobicularia piperata, Bellonius. *Op. cit.* ii. p. 444, v. pl. 45. f. 5.

Common amongst the muddy sand at the mouth of the Tay, and frequently thrown on the West Sands after storms; also procured from the fishing-boats.

Fam. 16. **Solenidæ**, Latreille.

Genus 3. SOLEN, L.

Solen pellucidus, Pennant. *Op. cit.* iii. p. 14, v. pl. 46. f. 4.

Common on the sandy ground, and thrown ashore in large numbers after storms; occasionally in the stomachs of cod and haddocks.

Solen ensis, L. *Op. cit.* iii. p. 16, v. pl. 47. f. 1.

Frequent on the sandy ground, and after storms on the West Sands.

Solen siliqua, L. *Op. cit.* iii. p. 18, v. pl. 47. f. 2.

Abundant amongst the sand uncovered by the low tides. The fishermen collect them for bait; and the children use them as scoops for digging in the sand.

Fam. 18. **Anatinidæ**, D'Orbigny.

Genus THRACIA, Leach.

Thracia papyracea, Poli. *Op. cit.* iii. p. 36, v. pl. 48. f. 4 & 4 *a*.

Common on the sandy ground off the West Sands, and cast ashore plentifully after storms.

Fam. 19. **Corbulidæ**, Fleming.

Genus 3. CORBULA, Bruguière.

Corbula gibba, Olivi. *Op. cit.* iii. p. 56, v. pl. 49. f. 6.

Off the East Rocks in a few fathoms, and on the beach after storms; good specimens are also procured from the fishing-boats.

Fam. 20. **Myidæ**, Fleming.

Genus MYA, L.

Mya arenaria, L. *Op. cit.* iii. p. 64, v. pl. 50. f. 1.

Frequent in the muddy sand at the mouth of the Eden. Distorted valves are common.

Mya truncata, L. *Op. cit.* iii. p. 66, v. pl. 50. f. 2.

Abundant off the mouth of the Eden, and on the beach after storms.

Fam. 21. **Saxicavidæ**, Swainson.

Genus 2. SAXICAVA, Fleurian de Bellevue.

Saxicava rugosa, L. *Op. cit.* iii. p. 81, v. pl. 51. f. 3 & 4.

Common at low-water mark amongst the rocks in crevices and holes in sandstone and shale, as well as inside empty limpet-shells and *Balani*. Often firmly adherent to its cavity by a byssus.

Fam. 23. **Pholadidæ**, Gray.

Genus 1. PHOLAS, Lister.

Pholas candida, L. *Op. cit.* iii. p. 107, v. pl. 52. f. 2.

Rarely found in shale at the Castle Rocks; commonly met with on the beach after storms, sometimes in a perfect condition.

Pholas crispata, L. *Op. cit.* iii. p. 112, v. pl. 53. f. 1.

Abundant in the soft shale and sandstone at East and West Rocks, and especially opposite the castle. Sometimes the siphons are observed protruding through sand which coats some of the ledges. Young specimens are often cast ashore on the West Sands in water-logged and decayed wood, whence they are extracted by the sea-fowl.

Genus 3. XYLOPHAGA, Turton.

Xylophaga dorsalis, Turton. *Op. cit.* iii. p. 120, v. pl. 53. f. 4.

Not common; several living specimens occurred in the wood of a submerged thorn tree.

Order SOLENOCONCHIA.

Fam. **Dentalidæ**, H. & A. Adams.

Genus DENTALIUM, L.

Dentalium entalis, L. *Op. cit.* iii. p. 191, v. pl. 55. f. 1.

Occurs on the West Sands in a living state after some storms. The specimens procured from the fishing-boats are generally tenanted by *Sipunculi*. Common.

[To be continued.]

XLIX.—*A Revision of the Genera* Epicharis, Centris, Eulema, *and* Euglossa, *belonging to the Family* Apidæ, *Section* Scopulipedes. By FREDERICK SMITH, Assistant in the Zoological Department of the British Museum.

[Continued from p. 322.]

Genus CENTRIS.

Centris (pt.), Fab. Syst. Piez. p. 354 (1804).
Trachina, Klug, Illig. Mag. vi. p. 226 (1807).
Hemisia, Klug, *ibid.* p. 227 (1807).
Ptilotopus, Klug, Berlin Mag. p. 32 (1810).

Generic characters.

Head not so wide as the thorax; eyes large, lateral, elongate-ovate; ocelli placed in a curve on the vertex; antennæ geni-

culate, the flagellum filiform, the first joint gradually narrowed to its base; the labial palpi four-jointed, the two basal joints elongate and flattened, the first longer than the second, the third and fourth minute and attached to the second joint near its apex; the maxillary palpi four-jointed, the first and fourth joints shorter than the intermediate ones; the mandibles stout, and with four blunt teeth in the females. *Thorax*: the anterior and intermediate tibiæ with a single spine at their apex; the posterior pair with two spines, the inner one pectinated: the anterior wings with one marginal and three submarginal cells; the marginal cell oblong, nearly as long as the three submarginals united, widest in the middle, truncate at the base, and more or less rounded at the apex, from which an appendicular nervure is emitted, which sometimes runs nearly to the anterior margin of the wing; the first submarginal cell is divided by a more or less distinct transverse, perpendicular, false nervure; the second cell is wider than the first, and *narrowed towards the discoidal cells*, receiving the first recurrent nervure towards the first submarginal; the third submarginal much narrowed towards the marginal cell.

Note. The mandibles tridentate in the males of many species.

1. *Centris furcata.*

Centris furcata, St.-Farg. Hym. ii. p. 151, ♀.
Bombus furcatus, Fab. Syst. Piez. p. 350.

Hab. Brazil; Demerara.

The male only differs in having the scape of the antennæ in front, the clypeus, the face on each side of it, and the labrum yellowish white.

2. *Centris denudans.*

Centris denudans, St.-Farg. Hym. ii. p. 150, pl. xx. fig. 1, ♀.
Trachina denudans, Latr., Schomb. Faun. et Flor. Brit. Guiana, p. 591.

Hab. Brazil (Tapajos, Ega); Ecuador.

The male differs from the female in having the clypeus and labrum yellow, and in having the anterior tibiæ and tarsi clothed with ferruginous pubescence.

3. *Centris thoracica.*

Centris thoracica, St.-Farg. Hym. ii. p. 158, ♀.

Hab. Brazil; Rio Grande.

4. *Centris pulverata.*

Centris pulverata, St.-Farg. Hym. ii. p. 161, ♀.

Hab. St. Paulo (Brazil).

I have seen the type specimen of this species. It is 1 inch

long. It is black, with the pubescence on the head black, that on the thorax a mixture of very short black and griseous, with a tuft of pale fulvous pubescence on each side of the metathorax; the first segment of the abdomen naked, the second and following segments covered with very fine, short, griseo-fulvous pubescence; the second segment more or less naked at the base and in the middle; the posterior legs densely clothed with ferruginous pubescence; wings dark fuscous, with a violet iridescence.

5. *Centris derasa.*

Centris derasa, St.-Farg. Hym. ii. p. 150, pl. xx. fig. 2, ♀.

Hab. Cayenne.

6. *Centris emarginata.*

Centris emarginata, St.-Farg. Hym. ii. p. 157, ♀ (*C. derasa*, var.?).

Hab. Cayenne.

7. *Centris americanorum.*

Ptilotopus americanorum, Klug, Berl. Mag. p. 32, tab. i. fig. 1, ♀ (1810).
Centris Langsdorfii, Blanch. Hist. Nat. des Ins. iii. p. 405, tab. vii. fig. 7, ♀ (1840).

Hab. Brazil (Tapajos and Para).

8. *Centris decorata.*

Centris decorata, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 372, ♂.

Hab. Pernambuco.

This species closely resembles *C. americanorum*, of which it may possibly be a local variety,—the differences being that the thorax in *C. decorata* is clothed with bright yellow pubescence, the sides of the basal segment of the abdomen have a pale yellow, and the second, third, and fourth segments are covered with olive-green pubescence; in *C. americanorum* the thorax is clothed with fulvous, and only the second and third segments have a covering of olive pubescence. Both examples described are in fine condition.

9. *Centris insignis.*

Centris insignis, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 375, ♀.

Hab. Columbia.

10. *Centris festiva.*

Centris festiva, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 375, ♀.

Hab. Columbia.

*11. *Centris discolor.*

Female. Length 11 lines. Black; the thorax clothed with fulvous pubescence above, beneath and on the legs it is black; the wings dark fuscous, with a violet iridescence; the abdomen has the sides of the second segment, and the third, fourth, and fifth segments with a grey sericeous pile.

Hab. Catagallo (Brazil).

12. *Centris rubella.*

Centris rubella, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 372, ♀.

Hab. Brazil (Tapajos); Archidona; Napo.

Specimens from the latter localities have the clypeus yellow anteriorly, as well as the labrum.

13. *Centris obsoleta.*

Centris obsoleta, St.-Farg. Hym. ii. p. 153, ♀.

Hab. Cayenne; Tapajos.

14. *Centris violacea.*

Centris violacea, St.-Farg. Hym. ii. p. 151, ♀.

Hab. Brazil.

15. *Centris nobilis.*

Centris nobilis, Westw. Nat. Libr. xxxviii. p. 263, tab. xx. fig. 1.
C. analis, St.-Farg. Hym. ii. p. 152.

Hab. Peru (Tabatinga); Brazil (St. Paulo).

16. *Centris ephippium.*

Centris ephippium, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 378, ♂.

Hab. Venezuela.

17. *Centris modesta.*

Centris modesta, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 371, ♂.

Hab. Santarem (Brazil).

*18. *Centris melanochlæna.*

Male. Length 10 lines. Black, clothed with black pubescence; the apical margin of the third segment of the abdomen laterally with a narrow fascia of cinereous pubescence, a broader fascia on the margin of the fourth segment inclining to ferruginous, and the two apical segments covered with ferruginous pubescence; the clypeus and labrum yellowish white, the former has two minute black dots at its base; the

labrum covered with black pubescence; wings dark brown, palest at the apical margins, and with a violet iridescence.

Hab. Mexico; Vera Cruz.

*19. *Centris agilis.*

Male. Length 9½ lines. Black, with the abdomen ferruginous. The thorax densely clothed with short sooty-black pubescence; that on the anterior and intermediate legs is of the same colour, as well as that on the posterior femora; on the tibiæ and tarsi of the posterior legs it is fulvous, the joints themselves being rufo-piceous; the claws of the tarsi black; the wings fuscous, darkest at their base; the labrum and clypeus yellow, and a yellow spot on the mandibles near their apex; the first segment of the abdomen black, sometimes the base of the second also.

Hab. Vera Cruz.

20. *Centris rufa.*

Centris rufa, St.-Farg. Hym. ii. p. 153, ♀.

Hab. Santarem (Brazil).

21. *Centris ferruginea.*

Centris ferruginea, St.-Farg. Hym. ii. p. 156, ♀.

Hab. Para; Tapajos (Brazil).

22. *Centris plumipes.*

Centris plumipes, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 373, ♀ ♂.

Hab. Tapajos (Brazil).

23. *Centris flavifrons.*

Centris flavifrons, St.-Farg. Hym. ii. p. 152, ♀.
Anthophora flavifrons, Fab. Syst. Piez. p. 375, ♂. In coll. Banks in Brit. Mus.

Hab. Ega, Santarem, &c. (Brazil).

24. *Centris (Xylocopa) mœrens.*

Centris (Xylocopa) mœrens, Perty, Del. Anim. Artic. Bras. p. 150, pl. 28. fig. 11.

Hab. Minas Geraes.

This species is black, and has the two basal segments sulphur-yellow; the wings dark fuscous. It is 14 lines long.

25. *Centris (Xylocopa) xanthocnemis.*

Centris (Xylocopa) xanthocnemis, Perty, Del. Anim. Artic. Bras. p. 150, pl. 28. fig. 12.

This insect is black; the pubescence on the thorax is yellow anteriorly and black posteriorly; the abdomen densely covered with olivaceous pubescence; wings of an iridescent blue; the posterior tibiæ and tarsi densely clothed with ferruginous pubescence. Length 11½ lines.

Hab. The province of Piauhi.

*26. *Centris personata.*

Male. Length 10 lines. Head and thorax black; abdomen ferruginous. The cheeks have a fine short white pubescence at the margins of the eyes, and a longer pale fulvous pubescence beyond. The pubescence on the thorax is sooty black above; beneath it is more or less tinged with fulvous; the prothorax has a little white pubescence on each side anteriorly, close to the head; the tarsi rufo-piceous, with the claws black; wings fusco-hyaline, the nervures fusco-ferruginous; the posterior legs with black pubescence. The abdomen with fulvous pubescence; at the apex, and also beneath, it is dense and bright. The clypeus and labrum reddish yellow; the front of the scape of the antennæ and the mandibles yellow, the latter have a black space a little before their apex; the clypeus has a large black spot at its base divided in the centre by a narrow yellow line; the labrum covered with short fulvous pubescence.

Hab. Tapajos, Ega (Brazil).

*27. *Centris ignita.*

Black, with the apex of the abdomen ferruginous. The head and thorax with black pubescence, that on the posterior tibiæ and first joint of the tarsi fulvous outside and ferruginous within, the joints are also ferruginous; the mandibles with a yellow spot near their apex; the wings dark fuscous, with a purple iridescence. Abdomen shining: the basal segment naked; the other segments have a thin sericeous hoary pile, which is observable in certain lights; the apical margin of the third segment ferruginous, the fascia is widest in the middle and at the sides of the abdomen; the fourth and following segments entirely ferruginous; beneath ferruginous, with more or less of fuscous spots or bands at the basal margins of the segments.

Hab. Orizaba (Mexico).

*28. *Centris semicærulea.*

Male. Length 8½ lines. Head and thorax black, abdomen blue. The pubescence on the face and vertex black, that on the cheeks and thorax above cinereous; the anterior and intermediate legs have a black pubescence, that on the posterior tibiæ and basal joint of the tarsi fulvous. The basal segment of the abdomen, and the apical margins of the following segments, with a fascia of pale fulvous pubescence; the wings fusco-hyaline; the clypeus and labrum yellow, the former with a minute black triangular spot at its anterior margin; a pale testaceous spot near the apex of the mandibles.

Hab. Venezuela.

29. *Centris flavopicta.*

Centris flavopicta, Smith, Cat. Hym. Ins. *Apidæ,* ii. p. 373, ♂.

Hab. Ega (Brazil).

30. *Centris mexicana.*

Centris mexicana, Smith, Cat. Hym. Ins. *Apidæ,* ii. p. 378, ♀.

Hab. Mexico.

31. *Centris dentata.*

Centris dentata, Smith, Cat. Hym. Ins. *Apidæ,* ii. p. 374, ♂.

Hab. Tapajos (Brazil).

32. *Centris maculifrons.*

Centris maculifrons, Smith, Cat. Hym. Ins. *Apidæ,* ii. p. 372, ♀.

Hab. Brazil; Mexico.

33. *Centris bombiformis* (*Hemesia*).

Centris bombiformis (*Hemesia*), Spin. Ann. Soc. Ent. France, x. p. 148, ♀.

Hab. Cayenne.

34. *Centris nitens.*

Centris nitens, St.-Farg. Hym. ii. p. 163, ♀.

Hab. Brazil.

35. *Centris lineolata.*

Centris lineolata, St.-Farg. Hym. ii. p. 158, ♀.

Hab. Ega, Tapajos (Brazil); Cayenne.

36. *Centris fasciata.*

Centris fasciata, Smith, Cat. Hym. Ins. *Apidæ,* p. 377, ♀ ♂.

Hab. Jamaica.

37. *Centris difformis.*

Centris difformis, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 374, ♀.

Hab. Tapajos (Brazil); Mexico.

38. *Centris longimana.*

Centris longimana, St.-Farg. Hym. ii. p. 164, ♀; Fabr. Syst. Piez. p. 356?

Hab. Cayenne; Ega; Tapajos; Para (Brazil).

39. *Centris picea.*

Centris picea, St.-Farg. Hym. ii. p. 166, ♀.

Hab. —— ?

40. *Centris versicolor.*

Centris versicolor, Fabr. Syst. Piez. p. 359; St.-Farg. Hym. ii. p. 154, ♀.
Apis versicolor, Fabr. Ent. Syst. ii. p. 340.

Hab. Vera Cruz; Oajaca (Mexico); I. Guadeloupe.

41. *Centris pœcila.*

Centris pœcila, St.-Farg. Hym. ii. p. 154, ♀.

Hab. Havanna.

42. *Centris hæmorrhoidalis.*

Centris hæmorrhoidalis, Fabr. Syst. Piez. p. 359, ♂; St.-Farg. Hym. ii. p. 155, ♀.

Hab. St. Domingo; Jamaica.

43. *Centris americanorum.*

Centris americanorum, St.-Farg. Hym. ii. p. 156, ♂.

Hab. Cayenne.

44. *Centris clypeata.*

Centris clypeata, St.-Farg. Hym. ii. p. 157, ♂.

Hab. Cayenne.

45. *Centris lineolata.*

Centris lineolata, St.-Farg. Hym. ii. p. 158, ♀.

Hab. Cayenne.

46. *Centris scapulata.*

Centris scapulata, St.-Farg. Hym. ii. p. 159, ♀.

Hab. Cayenne; Columbia.

47. *Centris decolorata.*

Centris decolorata, St.-Farg. Hym. ii. p. 160, ♂.

Note.—The type has only an interrupted line at the base of the second segment and a spot at the base of the third and fourth on each side.

Hab. Brazil; Mexico; St. Domingo.

48. *Centris maculata.*

Centris maculata, St.-Farg. Hym. ii. p. 160, ♀.
Hab. —— ?

49. *Centris punctata.*

Centris punctata, St.-Farg. Hym. ii. p. 169, ♀.
This species is allied to *C. lanipes.*
Hab. Catagallo; St. Paulo (Brazil).

50. *Centris dorsata.*

Centris dorsata, St.-Farg. Hym. ii. p. 161, ♀.
Hab. —— ?

51. *Centris chrysitis.*

Centris chrysitis, St.-Farg. Hym. ii. p. 162, ♀.
Hab. St. Paulo.

52. *Centris collaris.*

Centris collaris, St.-Farg. Hym. ii. p. 162, ♀.
Hab. St. Paulo.

53. *Centris bicolor.*

Centris bicolor, St.-Farg. Hym. ii. p. 163, ♀.
Hab. Goyanna (Brazil).

54. *Centris ænea.*

Centris ænea, St.-Farg. Hym. ii. p. 163, ♀.
Hab. Brazil.

55. *Centris lanipes.*

Centris lanipes, Fabr. Syst. Piez. p. 360, ♀; St.-Farg. Hym. ii. p. 165, ♀.
Apis lanipes, Fabr. Ent. Syst. ii. p. 340.
Hab. Brazil; Cayenne.

56. *Centris testacea.*

Centris testacea, St.-Farg. Hym. ii. p. 165, ♀.
Hab. St. Domingo.

57. *Centris picea.*

Centris picea, St.-Farg. Hym. ii. p. 166, ♀.
Hab. South America.

58. *Centris nigrescens.*

Centris nigrescens, St.-Farg. Hym. ii. p. 166, ♂.
Hab. Cayenne.

59. *Centris trigonoides.*

Centris trigonoides, St.-Farg. Hym. ii. p. 167, ♂.

Hab. Brazil.

60. *Centris fuscata.*

Centris fuscata, St.-Farg. Hym. ii. p. 167, ♂.

Hab. South America.

61. *Centris vittata.*

Centris vittata, St.-Farg. Hym. ii. p. 168, ♂ ♀.

Hab. Brazil.

62. *Centris bimaculata.*

Centris bimaculata, St.-Farg. Hym. ii. p. 168, ♀.

Hab. St. Paulo.

63. *Centris punctata.*

Centris punctata, St.-Farg. Hym. ii. p. 169, ♀.

Hab. South Brazil.

64. *Centris dentipes.*

Male. Length 5 lines. Head and thorax black, the abdomen ferruginous; the labrum, mandibles, and clypeus pale yellow, the latter black at the extreme base; tips of the mandibles rufo-piceous; the flagellum of the antennæ testaceous beneath, except the two apical joints, which are black; a tuft of pale pubescence above the clypeus, that on the vertex fuscous, and that on the cheeks white. Thorax: above the pubescence is fulvous, palest on the metathorax; beneath it is pale, inclining to white; legs ferruginous; the anterior and intermediate pairs fringed with whitish pubescence; on the posterior legs it is fuscous, except that on the femora and tibiæ above, which is pale fulvous; the posterior femora are incrassate, the coxæ with an acute spine at their apex; the wings hyaline and faintly clouded towards their apex. Abdomen with pale fulvous pubescence at its apex; the basal segment of the abdomen sometimes fusco-ferruginous.

Hab. Ega; Santarem; Tapajos; Para (Brazil); W. Indies, Mexico.

Specimens from Ega have the legs nearly black and the apical margins of the segments more or less fuscous. This species may possibly be that described by St.-Fargeau as *Centris trigonoides*; but he makes no mention of the spine on the coxæ. The species is allied to *C. lanipes.*

*65. *Centris ardens.*

Female. Length 7 lines. Head and thorax black, legs and abdomen ferruginous; the clypeus, labrum, mandibles, and scape of the antennæ in front pale yellow; a narrow fascia on the anterior margin of the clypeus, and two large subquadrate spots at its base, black; the mandibles ferruginous at their apex; the face covered with short pale downy pubescence, that on the vertex fuscous; the cheeks have a white pubescence. Thorax clothed above with dull ferruginous pubescence; on the sides and beneath it is pale and glittering; the legs with fulvo-ferruginous pubescence; wings subhyaline. Abdomen: a little pale fulvous pubescence at the base; the apical margin of the fifth segment and the sides of the sixth with bright fulvous pubescence; the first segment, and the apical margins of the second and third, with a band that is widest in the middle, abruptly narrowed toward the lateral margins, to which it does not extend, black; a waved black line in the middle of the fourth segment, and sometimes an indistinct one on the fifth, the two latter frequently wanting.

Hab. Ega (Brazil).

*66. *Centris apicalis.*

Female. Length 7½ lines. Head and thorax black; the three basal segments of the abdomen blue- or green-black; the three apical ones, the abdomen beneath, and the legs ferruginous; the apical segments, in some examples, more or less yellow; the scape of the antennæ in front; the clypeus, labrum, and mandibles yellow; the anterior margin of the clypeus narrowly black or nigro-piceous, the dark margin angulated in the middle, also a large black spot on each side at its base; the pubescence on the cheeks and face whitish, and fulvous on the vertex. Thorax clothed above with fulvo-ochraceous pubescence, paler on the sides and beneath; the pubescence on the legs fulvous; the wings hyaline. On the third segment of the abdomen there is usually a narrow abbreviated yellow line. The male differs only in having the clypeus entirely yellow, and in sometimes having a yellow line also on the second segment.

Hab. Saint Bartholomew.

*67. *Centris insularis.*

Female. Length 7 lines. Black; the abdomen nigro-æneous above, with the apical margins of the fourth and the following segments ferruginous. Head: the mandibles, labrum, clypeus, and scape of the antennæ in front yellow; a large ovate black

spot on each side of the clypeus at its base; its anterior margin narrowly rufo-piceous, the middle of the margin with an angulated black shape; the inner orbits of the eyes, as high as the insertion of the antennæ, yellow. The thorax clothed above with short yellowish-grey pubescence, pale yellow at the sides and whitish beneath; the legs ferruginous; the pubescence on the posterior tibiæ and basal joint of the tarsi pale fulvous; the inner side of the tarsal joint clothed with blackish pubescence; wings subhyaline, the nervures fusco-ferruginous. Abdomen: the basal segment with short pale yellowish pubescence; the apical margins of the two following segments rufo-piceous; beneath ferruginous; two lunate black spots at the base of the third and fourth segments; the second and two following segments have their apical margins fringed with pale pubescence.

Hab. San Domingo.

*68. *Centris apiformis.*

Length 7 lines. Head and thorax black, abdomen nigro-æneous. Head: labrum, clypeus, mandibles, and scape of the antennæ in front yellow; the clypeus with a broad black line on each side, and the mandibles with their inferior margins rufo-piceous; the flagellum, except the two basal joints, rufo-testaceous beneath; the cheeks with white pubescence, a tuft of the same between the antennæ, and another on the vertex, both usually more or less tinged with fulvous. Thorax clothed above with fulvous pubescence; on the sides, metathorax posteriorly, and beneath it is very pale fulvous; the legs rufo-piceous, the femora darkest; the anterior and intermediate tibiæ with a paler line outside; the base of the posterior pair also pale yellow; all the tibiæ and tarsi fringed behind with pale fulvous pubescence; wings subhyaline. Abdomen: a transverse nigro-æneous fascia on the second and third segments, and the basal margin of the fourth of the same colour; the apical segment rufo-testaceous, as well as the apical margins of the third and fourth segments, which are also thickly fringed with fulvous pubescence.

Hab. Santarem (Brazil).

*69. *Centris nitida.*

Female. Length 6½ lines. Black; the abdomen very smooth and shining; the thorax clothed above with pale yellow pubescence. Head: the mandibles and labrum yellow; an interrupted arched transverse band on the clypeus, and a line at the inner orbits of the eyes, which does not extend above the insertion of the antennæ, yellow; the flagellum of the antennæ

beneath, except the two basal joints, rufo-testaceous; the cheeks with white pubescence. Thorax: the pubescence at the sides and beneath very pale yellow; the anterior legs have a pale fringe on the femora and tibiæ behind, and the tarsi have a fulvous pubescence; the pubescence on the other legs is black; the wings subhyaline, their tegulæ white. Abdomen; the apical segment with fusco-ferruginous pubescence.

Hab. Honduras.

*70. *Centris nigro-cærulea.*

Female. Length 7 lines. Obscure blue-black; the entire pubescence black; the claw-joint of the tarsi fusco-ferruginous; the mandibles reddish yellow at their apex, with the tips of the teeth black; the wings fusco-hyaline, darkest at their base.

Male. Resembles the female, but has the labrum and clypeus white.

Hab. Mexico.

This species closely resembles the *Hemesia nigerrima* of Spinola from Chili, from which it differs in having the apex of the mandibles pale; its wings are darker, and its abdomen is more obscurely blue. The male of the Chilian species has the labrum and clypeus white: the clypeus is semicircular; in *C. nigro-cærulea* it is semiovate.

71. *Centris laticincta.*

Hemesia laticincta, Spin. Ann. Soc. Ent. Fr. x. p. 148, ♀ (1841).

Hab. Cayenne.

72. *Centris pyropyga.*

Hemesia pyropyga, Spin. Ann. Soc. Ent. Fr. x. p. 148 (1841).

Hab. Cayenne.

73. *Centris cineraria.*

Centris cineraria, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 378, ♀.

Hab. Chili.

74. *Centris chiliensis.*

Hemesia chiliensis, Spin. Faun. Chile, vi. p. 167, ♀.

Hab. Chili.

75. *Centris nigerrima.*

Hemesia nigerrima, Spin. Faun. Chile, vi. p. 167, ♀.

Hab. Chili.

*76. *Centris thoracica.*

Female. Length 7 lines. Black; the thorax above clothed with bright rich fulvous pubescence; that on the head, legs, thorax beneath, and on the abdomen black; the legs obscure nigro-piceous; the flagellum of the antennæ, except the two basal joints, testaceous.

Hab. San Domingo.

*77. *Centris concinna.*

Female. Length 7 lines. Head and thorax black; the legs and abdomen ferruginous, the latter black at the base above. The clypeus, face on each side of it, the labrum, mandibles, and scape in front yellow; a large subovate black spot at the base of the clypeus that terminates in a point in front, and which has a narrow yellow line down the centre; the pubescence on the cheeks white, that on the face and vertex fulvous. Thorax clothed with fulvous pubescence above, on the sides and beneath it is paler, on the legs it is fulvo-ferruginous; wings subhyaline; the tegulæ pale testaceous. Abdomen: the basal segment with pale fulvous pubescence; on the apical margin of the second and following segments it is fulvous.

Male. Smaller than the female, in all respects closely resembling it; the clypeus has a black line at its lateral margins; the abdomen has the second and third segments more or less ferruginous laterally.

Hab. Tapajos (Brazil).

*78. *Centris simillima.*

Female. Length 5 lines. Head and thorax black; legs and abdomen ferruginous. Head: the labrum, mandibles, clypeus, and face on each side of it yellow; the basal margin of the clypeus narrowly black, also an angulated black spot at its anterior margin. Thorax clothed above with pale fulvous, and beneath with whitish pubescence; on the tarsi, intermediate and posterior tibiæ the pubescence is fulvous; wings subhyaline; the tegulæ white.

Hab. San Domingo.

This species resembles *C. lanipes*; but the marking of the clypeus alone will distinguish it.

*79. *Centris perforator.*

Female. Length 6 lines. Head and thorax black, legs and

abdomen ferruginous. Head: the clypeus, labrum, mandibles, face on each side of the clypeus, and the scape in front yellow; two semicircular black spots on the clypeus; the flagellum of the antennæ, except the two basal joints, obscurely ferruginous beneath. Thorax clothed above with ochraceous pubescence, on the sides and beneath it is paler; the pubescence on the legs is pale fulvous; the posterior femora have a small tooth near their base beneath; wings subhyaline, their nervures fuscous. Abdomen: the basal segment with pale ochraceous pubescence, the three apical segments fringed at the sides with fulvous pubescence.

Hab. Pernambuco.

*80. *Centris terminata.*

Male. Length 5½ lines. Black, with the terminal joints of the tarsi rufo-piceous. Head: the clypeus, labrum, and mandibles pale yellow, the latter have sometimes only a yellow spot at the base; the flagellum of the antennæ, except the two basal and two apical joints, rufo-testaceous beneath; the pubescence on the cheeks and a tuft between the antennæ white; that on the vertex is dark fuscous. Thorax clothed above with fulvous pubescence; at the sides and also beneath it is griseous; the anterior and intermediate legs fringed behind with pale pubescence, that on the posterior pair is black, sometimes mixed with brown or obscure fulvous; wings subhyaline, the nervures brown. Abdomen with fulvous pubescence at the base and white at the apex; beneath thickly clothed with griseous pubescence, occasionally mixed with fulvous at the apex.

Hab. Para; Santarem; Catagallo (Brazil).

This is a variable insect in the coloration of its pubescence. Specimens from Catagallo have bright fulvous pubescence on the thorax; those from Para have it pale fulvous; the legs are black in the specimens from Catagallo, whilst in those from Para and Santarem they are usually more or less rufo-piceous.

*81. *Centris tarsata.*

Male. Length 4½ lines. Head and thorax black, legs and abdomen ferruginous. Head: the clypeus, labrum, and mandibles yellowish white, the tips of the latter ferruginous; the pubescence on the cheeks white, on the face and vertex it is yellowish, the latter has a mixture of fuscous; the flagellum of the antennæ, except the two apical and two basal joints, rufo-testaceous. Thorax clothed above with yellow pubescence, on the sides, beneath, and on the legs it is paler; the posterior

tarsi fringed with black pubescence; wings subhyaline, the nervures dark fuscous. Abdomen: the basal segment with yellow pubescence, the fringe on the apical segments whitish.

Hab. Santarem (Brazil).

82. *Centris elegans.*

Female. Length 8½ lines. Head, thorax, and legs black; the abdomen dark blue. Head: a longitudinal line on the clypeus and on each side of the anterior margin a transverse, oblong, pear-shaped spot, pointed within and almost uniting with the longitudinal line, a line at the inner margin of the eyes not extending above the base of the clypeus, two ovate spots on the labrum, and a spot at the base of the mandibles white, the tips of the latter also white; the pubescence on the head, thorax, and legs black; wings fuscous, palest at their apical margins. The abdomen obscurely testaceous beneath, its apical segments fringed with black pubescence.

Hab. Island of St. Vincent.

83. *Centris crassipes.*

Male. Length 5½ lines. Black; the clypeus, labrum, and mandibles white. The pubescence on the cheeks, a tuft at the base of the antennæ, and the fringe on the anterior femora behind white; the thorax clothed with mouse-coloured pubescence, behind the scutellum and at the base of the abdomen it is paler; the wings hyaline; the posterior femora and tibiæ incrassate; the pubescence on the posterior legs black. Abdomen shining black, with a blue tinge.

Hab. Jamaica.

84. *Centris picta.*

Female. Length 7 lines. Black, variegated with yellow spots and fasciæ. Head: the labrum, sides of the face as high as the insertion of the antennæ, a spot at each lateral anterior angle of the clypeus, and a minute spot at the base of each mandible yellow; the cheeks have a thin griseous pubescence, that on the vertex is fuscous. Thorax: a spot on each side of the collar, two on the tegulæ, and also two ovate ones on the scutellum yellow; the pubescence on the sides and beneath the thorax fuscous; the anterior and intermediate legs with black pubescence, except that on the tarsi beneath, which is ferruginous, the claw-joint being also ferruginous; the posterior legs more or less obscure ferruginous; the tibiæ and basal joint of the tarsi with long, dense, fulvous pubescence, the tarsal joint very broadly expanded, its pubescence on the inner side ferruginous. Abdomen: the

second, third, and fourth segments have at their basal margins a bright yellow fascia, the second being narrowest; the apical segments yellow; the fascia on the second segment expands laterally into an irregular ovate spot; beneath rufo-testaceous.

Hab. South Brazil.

This species is in the possession of Dr. Hermann Müller, of Lippstadt.

85. *Centris lanosa.*

Centris lanosa, Cresson, Hym. Texana, p. 284, ♂.

Hab. Texas.

[To be continued.]

L.—*Notes on the Small Spotted Eagle of Northern Germany,* Aquila maculata (*Gm.*). By H. E. Dresser, F.Z.S.

For some time I have been carefully working at the most difficult group amongst the eagles, that comprising those usually known by the name of "Spotted" Eagles, and have by no means yet been able to elucidate matters to my satisfaction. A day or two ago, however, my friend and late colleague, Mr. R. B. Sharpe, showed me the proof-sheets of a portion of his Museum catalogue, now in the process of publication; and I observed that he therein uses the name of *Aquila nævia* for the small Pomeranian and North-German Spotted Eagle. Although this species, in common with the larger Spotted Eagle which is found in Europe and Asia, has so long borne this name, I convinced myself, some months ago, that it certainly does not belong to it, though I am by no means sure to which species Gmelin's name of *nævia* should apply. I have, however, never published any information I have acquired on this subject; but as Mr. Sharpe, to whom I communicated some portion of it, wishes to refer to my notes in his catalogue, I have arranged with him to publish a short notice, giving the reasons why I refuse to accept the title of *Aquila nævia* for the smaller Spotted Eagle. They are as follows:—J. F. Gmelin, who first referred to an eagle under the name of *Falco nævius* (Syst. Nat. i. p. 258. no. 49), which has generally been looked on as being the Small Spotted Eagle, bases his description on that of Brisson's *Aigle tacheté* (Orn. i. p. 425. no. 4, 1760). Brisson, however, does not describe the bird from a specimen in his own possession, but refers to other authors, some of whose works (as, for instance, the one first mentioned, that of Schwenckfeld) are not to be had for reference. He refers,

however, to a plate in Frisch's 'Vögel Deutschlands' as giving an accurate representation of his "Aigle tacheté," in the following words:—"*Buteo*. Frisch. hujus icon accurata tab. 71." I possess a copy of Frisch's work; and on reference to the plate I found that the bird there represented is any thing but the Spotted Eagle, and might, I think, except for the partially feathered tarsi, possibly be meant to represent the Golden Eagle, though it does not agree with any stage of plumage of that bird which I have seen. It represents a large blackish brown eagle, regularly though indistinctly marked (so far as can be ascertained), by the centres of the feathers being darker than the outer portions; and the feathering on the tarsus only extends down to within about one third of the base of the claws, this latter portion being bare. Frisch, in his letterpress, speaks of it as the *Stein-Adler* or *Gänse-Aar* (the former being the German appellation for the Golden Eagle), and says that it is somewhat smaller than the Sea-Eagle. He further states that it has the tarsi only partly feathered, and is blackish brown in colour, like his *Aquila melanaëtus*, which is evidently the young of the Sea-Eagle. He speaks of having kept one for some time in captivity; and, so far as I can judge, the bird he had was a young Golden Eagle, more especially as he says that it inhabits rocky places and high mountains. He further writes that he thinks it may be a buzzard ("ich halte nicht ohne Grund dafür, es sey dieses der rechte Busaar oder Bushard"). The above, I think, clearly shows that the bird figured by Frisch, to which Brisson refers as being an accurate representation of his "Aigle tacheté," cannot possibly be the Spotted Eagle.

To return to Brisson, I may point out several reasons why his description cannot possibly refer to the small Spotted Eagle. He gives its total length as being 2 feet 7 inches and 6 lines, or, in our English measure, 33·7 inches, which utterly precludes its being this species, as an old and large female only measures in the skin 25 inches in length. He further speaks of the throat being dirty white, the *underparts* of the wings spotted, the underparts of the body generally dull ferruginous, the legs covered with dull ferruginous feathers and spotted with white, and the tail-feathers white at the base and the end, and otherwise dark ferruginous marked with large transverse brown spots, none of which characters agrees with young spotted specimens of this bird which I possess. I must confess that I am utterly unable to discover what species it is to which Brisson refers, but am quite convinced that it is not the small Spotted Eagle, which I hold must bear the name of *Aquila maculata* (Gm.), ex Lath.

J. F. Gmelin (Syst. Nat. i. p. 258. no 50) describes this eagle as follows:—"Longitudo bipedalis. Rostrum magnum et ungues nigri; irides cinereæ; pennæ scapularum et tectrices alarum apice macula ovali albicante insignitæ; dorsi maculis coloris bubalini; venter similibus lineis striatus," which description agrees well with a specimen in my collection from Silesia. He further refers to Latham, of whose description (Synopsis, i. p. 38. no. 15, 1781) he has evidently made use in giving the above characters. Latham's description is most clear, and certainly refers to the small North-German Spotted Eagle; and the only measurement he gives (the total length), which he says is 2 feet, agrees precisely with specimens of this bird in my possession. He states that his description was taken from a specimen in good condition in the British Museum, but he does not say where it was obtained.

I may add that on showing Mr. Sharpe my reasons for using the name of *maculata* instead of *nævia* for the present species, he quite agrees with me in the propriety of so doing.

LI.—*Description of an apparently new Species of Humming-bird of the Genus* Eriocnemis. By D. G. Elliot, F.L.S., F.Z.S., &c.

Eriocnemis chrysorama.

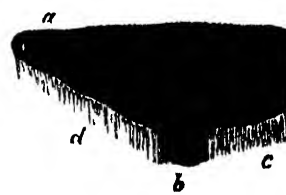
Top of head, back, flanks, breast, and abdomen brilliant metallic fiery red, darkest on the head; chin and throat metallic golden yellow; upper tail-coverts, extending half the length of tail, metallic yellowish green; under tail-coverts, basal half white, remainder metallic blue; wings purplish brown; tail much forked, steel-black; tufts on tarsi large, pure white; bill black; small spot on base of mandible, next to the chin, yellow, perhaps red in life. Total length 4¼ inches, wing 2½, tail 1¾, bill ¾.

This very brilliant and handsome bird approaches closest to the *E. mosquera*, and resembles it somewhat in the colour of the lower parts, but is more brilliant and fiery. It is, however, smaller in all its measurements except the bill. The throat-mark is very broad, and extends quite down to the breast.

I do not know the habitat of this species; but the specimen was stated to have come from Ecuador.

LII.—*On the Structure called* Eozoon canadense *in the Laurentian Limestone of Canada.* By H. J. Carter, F.R.S. &c.

I see by Dr. Carpenter's "Remarks" in the last number of the 'Annals' that, in my letter to Prof. King on the so-called "*Eozoon canadense*" ('Annals,' March 1874, xiii. p. 189), I did not lay sufficient stress on the *parallelism of the acicular structure with the grains of serpentine.* This is particularly well shown in the illustrations 1, 2, 3, 5, 6, 9, and 10 of Profs. King and Rowney's paper in the Transactions of the Royal Irish Academy, vol. x. p. 506, from which I have taken the liberty of causing to be copied fig. 1, pl. 1, which is reproduced in the following woodcut.



From the "description" of this figure, I learn that it represents "a portion of a 'chamber-cast' from a transparent section of 'eozoonal' ophite from Canada, presented to Dr. Rowney by Dr. Carpenter, as seen by reflected light with a power magnifying 120 diameters."

a is the portion of a 'chamber-cast,' *c d* the acicular structure or so-called "tubuli," "nummuline layer," or "nummuline tubulation," and *b* the serpentine seen through the latter.

Now I can testify to this, as well as to all the other illustrations of the kind given in this paper, as being correct instances of the *parallelism* of the aciculæ with the serpentine.

Hence this character is *utterly* incompatible with foraminiferal structure; for the tubuli of the chambers of the testaceous Foraminifera forming in juxtaposition a crust of columnar tubes which keep up a direct communication between the cavity of the chamber and the outer world, necessarily take the shortest course to produce this; and that course is therefore perpendicular to the surface or confines of the chamber and not parallel to it—in other words, a "straight line."

If there be any inclination, it is exceptional and not the rule; for Nature here, as in all other instances, is ever economic of her means.

Now what do we find in the so-called "eozoonal limestone"? that the acicular structure, which has been stated to represent the tubuli, is almost always *parallel* to the serpentine, after the manner shown in the illustration.

Thus, if there be even only one instance where the *parallelism* can be demonstrated, it would show that the aciculæ could

not have been the tubuli of a foraminiferal chamber; while its general occurrence makes the case conclusive.

It is instructive, if not amusing, to compare the facsimile illustrations of the eozoonal limestone given by the Galway mineralogists with the "constructed" figure of the same given by Dr. Carpenter's artist in the last number of the 'Annals;' and thus it may be understood why I stated to Dr. Carpenter that I had not read any thing that had been written on the opposite side of the question, or words to this effect (*l. c.* p. 278).

Beyond this structure it is not necessary to go for conviction. Of course the tubuli may not be seen in the arenaceous Foraminifera, where *sand* supplies the place of a *calcareous* test, but undoubtedly in the larger testaceous Foraminifera, where the test is formed of lime; and it so happens that to the structure of these I have heretofore chiefly directed my attention.

Before Schultze's or Carpenter's books were published, I had described and illustrated, in the 'Annals,' the canal-system, "nummuline" tubulation, and general structure of the Foraminifera, both in the recent *Operculina* and in the fossilized *Nummulite* ('Annals,' 1852, vol. x. p. 161, pl. iv.). Even Schultze in his book, as well as I can remember (for I have not the work by me to refer to), gives me the credit of having discovered the "canal-system," which at least proves the priority of my publications; and since then up to the present time I have more or less occupied myself with the structure of Foraminifera, as my papers in the 'Annals' will show.

Even during the last four years that I have been engaged in the general and microscopical examination of the British-Museum collection of sponges, for the purpose of bringing them into some kind of order and arrangement in that institution, this study has not been neglected; for, besides a variety of minute Foraminifera which I have found adhering to these sponges, that have come from various parts of the world, I have also had ample means of studying on them the beautiful little roseate *Polytrema*; so that I am able to speak decidedly of the great resemblance which the late Prof. Schultze is reported in the last number of the 'Annals' to have stated to exist between "*Polytrema* and *Eozoon canadense*."

As regards the "canal-system" in *Polytrema*, my mounted sections do not show any; nor do I think it should be expected that a foraminiferous structure merely consisting of cells heaped upon one another with wide intercommunications, finally terminated above in more or less erect branches, each of which presents several large trumpet-shaped openings for the exit of the body-sarcode, should require this "system." However it is stated by Schultze to exist; that is, the "Re-

port" states that "the application of stronger powers shows that in the finer structure of the canals [of the eozoonal limestone ?] there is so great an agreement with that of *Polytrema* among the living Acervulinæ, that, weighing all the other conditions of structure which come into consideration, there can be no serious doubt as to the foraminiferous nature of *Eozoon canadense*."

What "canals" are here meant in the translated "Report" it is difficult for me to see—that is, whether they be the "tubuli" or the "canal-system." The term "ramified canal-system" is mentioned in the former part of the "Report," but never the words "nummuline tubulation" or "tubuli." Still, as the position of the latter with respect to the chambers is the *sine quâ non* here, the "ramified canal-system" is, so far, of no consequence.

Thus we come to the identification of the tubuli of *Polytrema* with the aciculæ of the eozoonal structure; and here we have again a repetition of the fact before stated, viz. that in a mounted section of a thin slice of *Polytrema* wherein the tubuli can be best seen, they are in all places observed to pass directly *across* the walls of the chambers—that is, to be perpendicular to the surface or confines of the latter; while in the "eozoonal structure" the aciculæ, which have been stated to be identical with the tubuli, are observed to be *parallel* or tangential to the grains of serpentine.

That is to say, in the section of eozoonal limestone their *ends*, for the most part, may be seen around the grains of serpentine, while in the *walls* of the chambers in the section of *Polytrema* they are always seen to be *sidewise*.

In short the tubuli of the calcareous foraminiferous test are as perpendicular to the confines of the chambers as the lines of enamel to the dentine of a tooth. Now no one, under any circumstances, could make a section of a tooth in which the lines of the enamel would appear otherwise than perpendicular to the dentine; neither could he do the like with a foraminiferal chamber.

How is it, then, that the "aciculæ" to which I have alluded are seen *endwise* (*vide* woodcut) around and not perpendicular to the confines of the grains of serpentine, if the latter be the cast of a foraminiferous chamber?

Either the foraminiferous chambers and their tubuli of the species possessing calcareous tests (for we have nothing to do with arenaceous ones here) belie themselves, which is not likely, or the so-called *Eozoon canadense* in the Laurentian Limestone is *not* a fossilized foraminiferous structure.

That Schultze should have failed to realize this is not extraordinary under the circumstances.

LIII.—*Latest Observations on* Eozoon canadense *by* Prof. Max Schultze.

To the Editors of the Annals and Magazine of Natural History.

2 Hume Street, Dublin.
April 15th, 1874.

Gentlemen,

I have been requested to allow some extracts from letters received by me from my late much-lamented teacher Professor Max Schultze to be published, as bearing upon a subject which has lately been discussed in the 'Annals.' Perhaps if you will kindly publish these few remarks they may serve to throw some light upon the *latest* views entertained by that great authority on *Eozoon canadense.*

I have made no observations myself on *Eozoon*, and am in no way personally interested in the debate which is now going on as regards its true nature. The letters from which I translate extracts, as nearly *verbatim* as possible, were requests to me to procure for Professor Schultze some specimens of the stones from Drs. King and Rowney, from the examination of which they had drawn their conclusions as printed in the 'Proceedings of the Royal Irish Academy' for July 1869, which I had sent to him at his request a few days before the date of the letter which I now translate almost in full.

"Bonn, the 27th Dec. 1873."

"Dear Friend,—I have received Drs. King and Rowney's paper, and have to thank you most heartily for obtaining it for me so soon. Having read it, you must now let me trouble you again with another request. These gentlemen, with whom I agree on many important points, supported by my own investigations on *Eozoon canadense*, and whose treatise has made a very great impression upon me, would no doubt do me the kindness to let me have some specimens of the stones which they characterize as especially important, which it is very difficult for me to procure. It will give you but little trouble to acquaint them with the fact that I am engaged in the study of *Eozoon*, and am *most desirous* to obtain some pieces of 'Connemara ophites' and other ophites which I cannot procure in Germany. Perhaps you would undertake this for me, dear friend, and forward me the specimens as soon as possible by 'Parcel Delivery' or any other way known to you.

"Tell Messrs. King and Rowney that, with respect to the 'proper wall' of Carpenter, I am entirely of their opinion, that it is of inorganic origin, but would like to push my inves-

tigations further as regards the 'arborescent canal-system,' and desire very much, therefore, to have some pieces of *Eozoon canadense* in which the 'canal-system' is very distinctly developed. Forgive me if I give you a great deal of trouble; but . . . . &c.

"Hoping to be able to return your kindness some time or other,
"Yours in friendship,
"MAX SCHULTZE."

In another letter, dated Dec. 18th, 1873, he regrets not having yet received Drs. King and Rowney's paper, whereupon I immediately sent it to him; and he acknowledged the receipt of it in the above.

I may state that through the kindness of Dr. King I was enabled to send Professor Schultze some beautiful specimens of the stones he desired, and was expecting from him a letter of acknowledgment when I received the sad news of his death. I have, however, lately written to his widow begging her not to let any of his most recent papers be lost to science, but to have them published, and especially any remarks he may have written on the subject of *Eozoon*. She has not yet replied.

I have the honour to be, Gentlemen,
Yours faithfully,
ARTHUR E. BARKER,
Surgeon to the City-of-Dublin Hospital and Demonstrator of Anatomy in Roy. Coll. Surg. Ireland.

LIV.—*A List of Butterflies taken on the March to Coomassie by Lieutenant Alwin S. Bell, of the 2nd West-India Regiment, between Mansu and the River Prah, with Descriptions of new Species.* By W. C. HEWITSON, F.L.S.

FORTUNATELY for natural history as well as for my collection, Lieutenant Bell, to whom I am greatly indebted for butterflies taken under circumstances of so much interest, is a naturalist as well as a soldier; he most unfortunately, however, became so ill that he had to be sent back in a hammock to the coast and put on board the 'Victor Emmanuel' before he had penetrated further than the Prah. Lieutenant [illegible] slowly recovering from fever, speaks of the difficulty of procuring butterflies as great, from the narrowness of the pathways and the density of the bush. Many of them flew only high over head, and never came within his reach.

The list I send is remarkable for the number of species in a collection of less than one hundred specimens.

Papilio Leonides.
—— Policenes.
—— Nireus.
—— Cynorta.
—— Zenobius.
Pieris Theona.
Pontia Xiphia.
Eronia thalassina.
Terias Brenda.
Acræa Cidonia.
—— serena.
——, n. sp.
Atella Phalanta.
Junonia Terea.
Salamis Anacardii.
—— Cytora.
Danais Niavius.
—— Limniace.
Eurema Delius.
Diadema Anthedon.
Charaxes Lucretius.
—— Ephira.
Euriphene Sophus.
—— Mandinga.
—— Phantasia.
Aterica Cupavia.
Jaeria cœnobita.
—— crithea.
Harma Iodutta.
—— Theobene.
—— Fumana.
Neptis Melicerta.
—— Nicomedes.
Kallima Rumia.
Mycalesis Xeneas.
——, n. sp.
Eurytela Hiarbas.
—— Ophione.
Ergolis Corita.
—— Enothrea.
Libithea Labdaca.
Epitola, n. sp.
Loxura Alcides.
Liptena Libyssa.
—— Milca.
Pentila, three new species.
Lycænesthes Larydas.
—— Liguros.
Hypolycæna Antifaunus.
—— Faunus.
—— Lebona.
Lycæna Telicanus.
—— Jesous.
—— Hippocrates.
—— Lingeus.

Acræa acerata.

Upperside orange. Both wings with the outer margins broad, dark brown. Anterior wing with the base and two large triangular spots on the costal margin dark brown.

Underside paler. Both wings with the outer margins as above, marked on the margin by a series of triangular rufous spots. Anterior wing with a lunular black spot at the end of the cell, and a large triangular brown spot on the costal margin as above. Posterior wing with eleven or twelve black spots near the base.

Exp. $1\frac{1}{4}$ inch.

Belongs to the group which contains *A. serena* and *A. Eponina*, of which group I have another new species from Angola.

Mycalesis Madetes.

Upperside. *Male* dark brown. Anterior wing with a tuft of hair near the inner margin below its middle.

Underside rufous brown. Both wings crossed at the middle by a dark brown linear band bordered outwardly with lilac;

both with a zigzag band near the outer margin: the margin and a submarginal line black: both ornamented by a series of black ocelli, the pupils white, the iris orange: on the anterior wing three, the third large; on the posterior wing seven, the fifth large. Anterior wing crossed in the cell by two dark brown lines. Posterior wing crossed near the base by a line of the same colour.

Exp. $1\frac{6}{10}$ inch.

Mr. Rogers has sent me this species from the Gaboon.

Epitola Belli.

Upperside. *Male* brilliant morpho-blue. Anterior wing with the costal margin, which is broad and marked at its middle by a trifid blue spot, and the apical half black. Posterior wing with the costal margin brown; the outer margin black, intersecting the blue at the nervures.

Underside. Anterior wing dark brown, brassy at the apex: two white spots (one minute) within the cell, a blue line at the end of the cell, and an angular band of six white spots near the middle. Posterior wing brassy brown.

Exp. $2\frac{2}{10}$ inch.

This species is the most beautiful of the genus, and is of the same form as *E. Elais*. I have named it after my friend, and in memory of a time which he will not easily forget.

Pentila Picena.

Upperside white, slightly tinted with yellow. Both wings with a round black spot at the end of the cell. Anterior wing with the costal margin and apex, which is broad, brown.

Underside with the black spots as above. Anterior wing white, with the costal margin and apex yellow, the outer margin marked by a series of small black spots. Posterior wing yellow.

Exp. $1\frac{3}{10}$ inch.

Pentila Petreia.

Upperside rufous orange. Anterior wing with the costal margin, the apex, and outer margin broadly dark brown: a round spot in the cell and a second at the end of the cell black. Posterior wing with the outer margin brown, broad: a minute black spot on the costal margin before its middle, and a larger spot of the same colour at the end of the cell.

Underside as above, except that there are no dark brown margins, the space which they occupy above being thickly undulated with brown, that there are two small brown spots

at the anal angle of the anterior wing, and that the whole of the posterior wing is undulated with brown.

Exp. $1\frac{4}{10}$ inch.

This species is nearly allied to *P. Amenaida*, but is smaller and much more sparsely spotted.

Pentila Phidia.

Upperside white. Both wings marked near the centre by three round black spots in the form of a triangle. Anterior wing with the costal margin and apex broadly orange: the outer margin dark brown, divided into spots towards the anal angle. Posterior wing with a series of dark brown spots on the outer margin.

Underside as above.

Exp. $1\frac{4}{10}$ inch.

This is probably a variety of *Pentila Abraxas* of the 'Genera.'

LV.—*Additions to the Australian* Curculionidæ. Part VI. By Francis P. Pascoe, F.L.S. &c.

Otiorhynchinæ.

Timareta crinita.

Cleoninæ.

Lixus Breweri.
—— Mastersii.

Erirhininæ.

Glaucopela, n. g.
—— unicolor.
Phæodica, n. g.
—— fulvicornis.
—— scutellaris.
Empira, n. g.
—— variegata.

Amalactinæ.

Tranes insularis

Apioninæ.

Apion comosum
—— pulicare.
—— argutulum.

Rhinomacerinæ.

Auletes filirostris.
—— calceatus.
—— turbidus.
—— nigritarsis.

Timareta crinita.

T. ferruginea, squamulis albis adpressis, plurimis majoribus suberectis, lateribus setulosis, sat dense vestita; capite inter oculos depresso, paulo incurvato; rostro brevi; scrobibus triangularibus, ampliatis; funiculo gracili, articulo primo quam secundo longiore; prothorace latitudine paulo breviore, squamis majoribus irrorato; elytris leviter striato-punctatis, interstitiis uniseriatim squamis majusculis instructis; corpore infra sparse, pedibus magis con-

fertim et longe pilosis; tibiis posticis in mare ad apicem valde curvatis. Long. 2 lin.

Hab. Fremantle.

This species has a mottled appearance to the naked eye, owing to the uncovered derm around each of the larger scales on the prothorax and the baldness in parts of the striæ on the elytra. The scape is more than half as long again, and proportionally more slender than in *T. figurata*.

Lixus Breweri.

L. niger, subnitidus, squamulis piliformibus silaceis, plurimis elongatis maculatim condensatis, vestitus; rostro crassiusculo, prothorace breviore, parum arcuato, irregulariter punctulato, haud carinato; antennis subferrugineis, clava oblongo-elliptica; prothorace subconico, longitudine latitudini æquali, confertim punctato, lateribus silaceis; elytris striato-punctatis, interstitiis convexis, apicibus acuminatis; corpore infra pedibusque tenuiter griseo-pilosis, illo flavo-pollinoso. Long. 6 lin.

Hab. Albany.

In size and outline resembling *L. Myagri*, but, *inter alia*, the rostrum not carinate. The spotted appearance is due to patches of longish, erect, hair-like scales; and this character will at once distinguish it from *L. tasmanicus*, Germ. Of the latter I have specimens from Victoria, West Australia, and Queensland. It is unaccountable to me why Germar, who described it from an admittedly Adelaide specimen (or specimens), should have so named it, as it is not known to occur in Tasmania. *Lixus australis*, Boisd. (I rely on the identification from a specimen out of a Paris collection), has an elongate conical prothorax, and closely resembles the Javan *L. binodulus*. Dedicated to Mr. Brewer, who has now for some years been collecting the insects of West Australia.

Lixus Mastersii.

L. niger, subnitidus, squamis piliformibus griseis omnino leviter vestitus; capite inter oculos fovea profunda impresso; rostro crassiusculo, brevi, vix arcuato, disperse piloso; antennis nigris, pubescentibus; scapo brevi; prothorace conico, latitudine paulo longiore, confertim punctato; elytris cylindricis, sulcato-punctatis, punctis majusculis, approximatis, interstitiis parum convexis, apicibus rotundatis. Long. 5 lin.

Hab. New South Wales (Rope's Creek).

This species is remarkable for its comparatively very short rostrum; a more sparsely distributed pubescence just behind

the middle of each elytron gives them a slightly patchy appearance. *L. immundus*, also with a short rostrum, has, *inter alia*, ferruginous antennæ and the prothorax canaliculate.

GLAUCOPELA.

Rostrum subulatum, arcuatum, basi ampliatum, haud striolatum; *scrobes* postmedianæ, obliquæ. *Scapus* brevis; *funiculus* 7-articulatus, articulo primo majusculo, cæteris gradatim brevioribus; *clava* distincta, subglobosa. *Oculi* ovati, subtenuiter granulati. *Prothorax* transversus, utrinque ampliato-rotundatus, apice angustissimus, basi paulo bisinuatus, lobis ocularibus nullis. *Elytra* subcordata, prothorace multo latiora. *Coxæ* intermediæ subapproximatæ. *Femora* crassa, mutica; *tibiæ* intus bisinuatæ, anticæ apice submucronatæ; *tarsi* modice dilatati. *Abdomen* segmentis duobus basalibus valde ampliatis.

This genus is differentiated from *Erytenna* by its subulate rostrum and the basal position of the scrobes, accompanied by a corresponding shortness of the scape. *Cydmæa* has the prothorax more rounded at the base, or, in other words, not lobed opposite the scutellum, and the rostrum striated at the base and cylindrical throughout.

Glaucopela unicolor.

G. fusca, squamis viridi-griseis dense induta; rostro prothorace paulo breviore, nitide fusco; antennis nigris; prothorace apice tubulato, quam basi fere triplo angustiore; elytris sulcatis, interstitiis modice convexis, in medio squamis linearibus elongatis uniseriatim dispositis, humeris callosis, apicibus rotundatis; corpore infra pedibusque squamis viridi-opalescentibus dense tectis; tarsis articulo ultimo testaceo. Long. 2 lin.

Hab. Champion Bay.

PHÆODICA.

Rostrum arcuatum, subulatum, apice cylindricum; *scrobes* præmedianæ, obliquæ, infra rostrum currentes. *Scapus* longiusculus, oculum haud attingens; *funiculus* 7-articulatus, articulo primo ampliato, secundo obconico, cæteris brevibus; *clava* ovata, distincta. *Prothorax* subtransversus, basi rotundatus, lobis ocularibus obsoletis. *Scutellum* triangulare. *Elytra* oblongo-cordata, prothorace latiora. *Coxæ* intermediæ subremotæ. *Femora* crassa, mutica; *tibiæ* intus bisinuatæ, anticæ mucronatæ; *tarsi* articulo penultimo fortiter bilobo. *Abdomen* segmentis duobus basalibus ampliatis.

The intermediate coxæ are wider apart than in *Olanæa*, in which they may be said to be approximate, but less so than in *Dicomada* and *Cydmæa*; from these two, with which this

genus agrees in habit and in the rounded base of the prothorax, it may be at once distinguished by the scrobes running beneath the rostrum.

Phæodica fulvicornis.

P. nigra, supra squamis griseo-albis sejunctim vestita; rostro nigro, squamoso, apice nudo fulvescente excepto; antennis fulvescentibus; prothorace utrinque rotundato, basi quam apice duplo latiore; scutello squamoso; elytris leviter sulcatis, interstitiis planatis, irregulariter squamosis, humeris obliquis; corpore infra pedibusque argenteo-squamosis. Long. 1½ lin.

Hab. West Australia.

Phæodica scutellaris.

P. nigra, supra squamis roseo-griseis sejunctim vestita; rostro magis tenuato, nigro, apicem versus aliquando fulvescente; antennis fulvescentibus, vel paulo infuscatis; prothorace latitudine vix breviore, apice quam basi fere duplo angustiore; scutello esquamoso, nigro; elytris leviter sulcatis, interstitiis planatis, squamis seriatim dispositis, humeris subrotundatis; corpore infra pedibusque argenteo-squamosis. Long. 1¼ lin.

Hab. Swan River.

The elytra in nearly all my specimens are more or less varied with blackish patches, in part but not invariably owing to slight abrasions. The rosy tint is sometimes scarcely noticeable.

EMPIRA.

Rostrum prothorace paulo brevius, subrobustum, arcuatum; *scrobes* præmedianæ, paulo obliquæ, ad partem inferiorem oculi antice currentes, basin versus ampliati. *Oculi* transversi, ovati, fortiter granulati. *Scapus* oculum haud attingens, apice clavatus; *funiculus* 7-articulatus, articulo basali amplo, duobus sequentibus longiore, cæteris subobconicis, ultimis transversis; *clava* elongata, distincta. *Prothorax* transversus, utrinque parum rotundatus, basi subbisinuatus, lobis ocularibus obsoletis. *Scutellum* parvum. *Elytra* prothorace paulo latiora, subcylindrica. *Pectus* antice profunde emarginatum. *Pedes* mediocres; *femora* valida, mutica; *tibiæ* subcylindricæ, intus bisinuatæ, apice mucronatæ; *tarsi* lati, breviusculi, articulo ultimo valido; *unguiculis* divaricatis. *Abdomen* segmentis duobus basalibus ampliatis.

The rostrum is intermediate in thickness between the general run of the Hyperinæ and of the Erirhininæ; but in habit it seems more akin to the former. The stout claw-joint and its divaricate claws, however, are foreign to the group; but there is an approach to these characters in some of the Erirhininæ, in which I have therefore placed it.

Empira variegata.

E. ferruginea, supra squamulis lutescentibus variegata; capite rostroque nigris, hoc sejunctim punctulato; antennis subferrugineis, rarissime albo-pilosis; prothorace sat dense squamoso; elytris striato-punctatis, interstitiis latis, parum convexis, quarta parte apicali basique sat dense, intermedia magis sparse, vel subplagiatim, squamulosis; pedibus clare ferrugineis, squamulis piliformibus parvis valde adspersis; corpore infra nigro, niveo-squamoso. Long. $1\frac{1}{3}$ lin.

Hab. Swan River.

Tranes insularis.

T. niger, nitidus, squamulis angustis silaceis, in fasciam pone medium elytrorum condensatis, adspersus; oculis supra approximatis; rostro prothorace fere sesquilongiore, tenuiter punctulato; antennis ante medium rostri insertis; scapo quam funiculo longiore, articulis duobus basalibus elongatis, æqualibus; prothorace transverso, utrinque ampliato-rotundato, tenuiter confertim punctulato; scutello parvo; elytris prothorace manifeste latioribus, apice obtuse rotundatis, striato-punctatis, punctis subquadratis, interstitiis parum convexis, vage subtiliter punctulatis; corpore infra pedibusque squamis piliformibus parvis parcius adspersis; apice tibiarum tarsisque magis dense silaceo-pilosis. Long. $6\frac{1}{2}$ lin.

Hab. Lord-Howe Island.

This fine species most resembles *T. Roei* in outline. It differs, however, from all other species known to me in the length of the scape and of the first two joints of the funicle, the remainder being rather shortly obconic, and in the eyes approximating above. The anterior coxæ are absolutely contiguous, as in *T. monopticus.*

Apion comosum.

A. rufo-testaceum, leviter griseo-pubescens; rostro tenuato, cylindrico, modice arcuato, subtiliter punctulato, in mare capite prothoraceque conjunctim paulo longiore; antennis ad quartam partem a basi insertis; oculis nigris, mediocribus; prothorace basi longitudine paulo latiore; elytris fortiter sulcatis, interstitiis convexis; coxis intermediis modice approximatis; unguiculis nigris. Long. 1 lin.

Hab. Swan River; Queensland.

Much like *A. Malvæ*; but unicolorous, and with a considerably more slender rostrum. The sculpture of the elytra is only seen when the rather coarse pubescence is rubbed away. Mr. Masters sends me two specimens (♂ and ♀) from

Queensland, which I cannot distinguish, except by their dark underpart, from others from Swan River; the female in the former, however, has a much shorter rostrum.

Apion pulicare.

A. rufescens, leviter griseo-pubescens; rostro valido, sat fortiter arcuato, prothorace multo breviore; antennis basin versus rostri insertis; oculis nigris, ampliatis; prothorace subtransverso, basi fortiter bisinuato; scutello conspicuo; elytris basi prothorace multo latioribus, punctato-sulcatis, interstitiis latis convexis; coxis intermediis approximatis; unguiculis nigris. Long. 1 lin.

Hab. Swan River.

A stouter species than the preceding, with a proportionally stouter as well as shorter rostrum.

Apion argutulum.

A. nitide atrum; capite elongato, inter oculos bisulcato, collo lævigato; rostro prothorace fere duplo longiore, modice arcuato, subpunctato, apicem versus subulato; antennis pone medium rostri insertis; oculis modice ampliatis; prothorace cylindrico, sparse punctato, latitudine longiore; scutello elongato; elytris brevibus, pone medium prothorace duplo latioribus, punctato-sulcatis, sulcis basin versus approximatis, interstitiis modice convexis, fere obsolete punctulatis, humeris prominulis; pedibus elongatis. Long. 1 lin.

Hab. Queensland.

In habit like *A. nigritarsis*, but, *inter alia*, with more globose elytra and stouter legs. Of this cosmopolitan genus of between 300 and 400 species the above are the only species hitherto described from Australia.

Auletes filirostris.

A. testaceus vel lutescens, sparse albo-pubescens; capite prothoraceque rude punctatis; rostro tenuato, elongato, apicem versus crassiore; antennis longis, prope basin rostri insertis; clava nigra; prothorace capite latiore, utrinque fortiter rotundato, apice quam basi manifeste angustiore; scutello nitido; elytris modice elongatis, tenuiter punctatis, pone scutellum transverse leviter impressis; pedibus sparse setulosis. Long. 1½ lin.

Hab. Albany.

A well-marked species; the rostrum, nearly twice as long as the prothorax, far exceeds that of any other species.

Auletes calceatus.

A. subnitidus, lutescens, obsolete pubescens; capite rostro (apice excepto) articulisque duobus ultimis tarsorum nigris; capite minus transverso, sat rude punctato; rostro capite duplo longiore, sparse punctulato; antennis versus basin rostri insertis; clava nigra; prothorace subtransverso, rugoso-punctato, basi apiceque æquali; scutello fusco; elytris subovatis, prothorace multo latioribus, subseriatim fortiter punctulatis, humeris prominulis, sutura fusca; corpore infra nigro. Long. 1¼ lin.

Hab. Champion Bay.

A comparatively robust, coarsely punctured species.

Auletes turbidus.

A. nitido fulvus, subtiliter pubescens; capite transverso, infuscato; oculis ampliatis, prominulis; rostro capite prothoraceque conjunctim breviore, impunctato, apicem versus ampliato; antennis basin versus rostri insertis, articulo primo clavaque infuscatis; prothorace transverso, utrinque fortiter rotundato, et basin versus tumidulo, parce mediocriter punctulato; scutello parvo; elytris parum elongatis, tenuiter parce punctulatis, stria suturali distincta, sutura fusca; corpore infra articulisque duobus ultimis tarsorum fuscis. Long. 1 lin.

Hab. South Australia (Gawler).

Allied to the preceding, but less robust and with finely punctured elytra.

Auletes nigritarsis.

A. nigro-piceus; capite valde transverso; oculis ampliatis, prominulis; rostro a basi ad apicem gradatim incrassato, parum arcuato, capiti prothoracique conjunctim longitudine æquali; antennis prope basin rostri insertis, flavidis, articulo primo clavaque fuscis; prothorace subtransverso, parce punctato, pone medium fortiter rotundato; scutello inconspicuo; elytris breviusculis, tenuiter sat sparse punctulatis, stria suturali distincta; abdomine metasternoque nigris; pedibus flavidis, tarsis nigris. Long. ¾ lin.

Hab. South Australia; West Australia.

Like the European *A. tubicen*, but head, rostrum, eyes, &c. different.

LVI.—*Remarks on the Subject of* "Eozoon." By Prof. King, D.Sc., and Prof. Rowney, D.Ph.

We have no intention of entering on the discussion opened up by Mr. Carter, F.R.S. &c., in his letter to one of us, and the reply to it by Dr. Carpenter, that have lately appeared in the 'Annals;' feeling satisfied that the constructors of the so-called *Eozoon canadense* have quite sufficient to attend to in answering the evidences and arguments already brought forward in the papers we have published against its presumed organic origin. Hitherto, and we regret to say it advisedly, no proper attempt has been made to do so.

In our early investigations, and after having fully satisfied ourselves that the various eozoonal structures could not be the remains of an organism, we felt it to be our duty to make an attempt at explaining their mineral origin. They looked much like dendromorphs and acicular crystallizations; but we soon found that they were not productions of these kinds, nor concretions, nor infiltrations: instead of being incremental, they were obviously decremental. Consisting for the most part of serpentine (an amorphous hydro-silicate of magnesia), this mineral was seen to be affected by an irregular septarian and a subparallel divisional structure, accompanied by some remarkable changes, one fibrous (known to mineralogists as chrysotile), another arborescent (? metaxite), and another flocculent—all usually of a white colour. Very frequently calcite prevails in the divisional interspaces in association with the latter allomorphs. In such cases the serpentine is broken up into irregularly lobulated or segmented grains, lumps, and plates, separated by the calcitic interspaces; in which are imbedded examples of the three allomorphs: the chrysotile is generally an integral portion of the grains and plates of serpentine, forming patches of asbestiform coating. The plates of serpentine and their calcitic interspaces occasionally give rise to remarkable interlaminations, while the grains (usually attached to one another, but occasionally isolated) occur irregularly scattered amongst the calcite. Not unfrequently the serpentine assumes the condition of chrysotile *without any calcite being present*. A close investigation enabled us to see not only the serpentine passing insensibly into compact or true chrysotile and flocculite (as, for the sake of brevity, it may be called), but that the one often became separately acicular, and the other changing from rudely shaped masses into simple and complex arborescences (like those in metaxite), simulating, in the most remarkable manner, sponge-structures and dendritic crystallizations. The evidences were so clear and

complete as to prevent our coming to any other conclusion than that they were residual bodies, and not concretions, infiltrations, or crystallizations. As to their being portions of an organism, the idea would not bear any serious consideration. Wherever the changes had taken place, a carbacid mineral (calcite, or dolomite) had replaced the chrysotile, flocculite, and metaxite; so that it became evident that we had before us the results of chemical changes analogous to certain kinds of pseudomorphosis occurring among minerals.

Not only does serpentine present unmistakable evidences of the above changes, but certain of them have occurred to us in other silacid minerals, as malacolite and Wollastonite. Agglomerations of minute crystals of these minerals are common in certain so-called primary limestones (notably at Aker in Sweden, Amity in New York, and in Ceylon), so reduced by solvent or chemical action (the component crystals still retaining in many cases their original angles, edges, and planes) as to assume the exact forms of the "eozoonal canal-system" in its typical condition, and showing clearly their residual character, also the replacement of their lost or eroded portions by the calcite or dolomite in which they are imbedded.

A more important discovery we had not anticipated. It opens out a wide field of research in chemical geology, an insight into which, however, has been afforded by the illustrious Bischof. Of late the subject has been frequently under our consideration. It is well known that certain rocks are not in their original chemical condition: the changes in serpentine render it extremely probable that ophite (a silocarbacid rock) is a chemically changed or methylotic product, that the Tyree, Aker, and other crystalline marbles were originally silacid masses, and possibly that much of the so-called "limestones" occurring in the Laurentians of Canada were, in Archæan periods, silacid members of true gneisses, diorites, and other related rocks *. We need not dwell any longer on this subject; suffice it to say that we are pursuing a number of researches in connexion with it. We have been favoured with specimens by Mr. F. R. Mallet, of the Indian Geological Survey, discovered by himself in dolomitic bands intersecting transversely beds of gneiss at South Mirzapur †, showing typical eozoonal structures beautifully developed through methylotic action; and last summer one of us obtained at the Lizard, Cornwall, aided by the kindness of Mr. Symons, manager of the Poltesco marble-works, a number of speci-

* See a paper by one of the writers in the 'Geological Magazine' for January 1872.

† Records of the Geological Survey of India, No. 1, 1872.

mens out of apparently a most unpromising rock (serpentinite, rarely including any carbacid members), showing its characteristic mineral not only changing as "eozoon" into calcite, but also as a pseudomorph after augite, &c. A description of these cases is in preparation for publication.

Our view is that the changes referred to have resulted from the action of heated water holding a carbonate in solution.

But to return to "*Eozoon.*" Dr. Carpenter has kindly offered "to give time and trouble to enable those who wish to make the comparison of actual specimens for themselves." We would strongly urge on them to take advantage of this offer. We may be permitted, however, to supplement it by suggesting their careful perusal of the memoirs that have been published by us descriptive of similar specimens*, not forgetting those published by Dr. Carpenter and others on his side.

Attention may next be called to the following summary of the arguments and evidences contained in the memoirs referred to:—

1st. The serpentine in ophitic rocks (consisting essentially of serpentine and calcite, with which various other minerals, chiefly silacids and carbacids, are often associated) we have shown to present appearances which can only be explained on the view that it has undergone structural and chemical (methylotic) changes:—the former causing it to pass into different subdivided states; and the latter etching out the resulting solids into a variety of forms—grains and plates with lobulated or segmented surfaces ("chamber-casts," see Dr. Carpenter's fig. 1), fibres and aciculæ ("nummuline chamber-wall"), simple and branching configurations ("canal-system"). Crystals of malacolite and other silacid minerals (often occurring in ophite and other silo-carbacid rocks) manifest some of these changes in a remarkable degree.

2nd. The "intermediate skeleton" of "*Eozoon*" (which often appears as the calcitic matrix of the above lobulated grains &c.†) is completely paralleled in various crystalline rocks, notably marble containing grains of coccolite (Aker and Tyree), pargasite (Finland), chondrodite (New Jersey), &c.

3rd. The "chamber-casts" in the granular (acervuline) variety of "*Eozoon*" are more or less paralleled by the grains of the silacid minerals in the precited marbles.

* Quarterly Journal of the Geological Society, vol. xxii.; 'Proceedings of the Royal Irish Academy,' vol. x.; *ibid.* new series, vol. i.; 'Geological Magazine,' January 1873.

† This part is dissolved out (artificially) in fig. 1. Dr. Carpenter's fig. 2, exhibiting the various eozoonal features, must be taken merely as an illustration, it being a *constructed* representation.

4th. The "chamber-casts" being composed occasionally of Loganite and malacolite (besides serpentine) is a fact which, instead of favouring their organic origin as supposed, must be held as a proof of their having been produced by mineral agencies, inasmuch as the three silacid minerals named have a close pseudomorphic relationship, and may therefore replace one another.

5th. Dr. Gümbel, observing rounded, cylindrical, and tuberculated grains of coccolite and pargasite in crystalline calcitic marbles, considered them to be "chamber-casts," or of organic origin. We have shown that such grains often present crystalline planes, angles, and edges—a fact clearly proving that they were originally aggregations of simple or compound crystals that have undergone external decretion by chemical or solvent action.

6th. We have adduced evidences to show that the "nummuline chamber-wall"* in its typical condition (that is, consisting of cylindrical aciculæ separated by interspaces filled with calcite) has originated directly from closely packed fibres, these from chrysotile or asbestiform serpentine, this from incipiently fibrous serpentine, and the latter from the same mineral in its amorphous or structureless condition †.

7th. The "nummuline wall," in its typical condition, unmistakably *occurs in cracks or fissures*, both in Canadian, Connemara, and other ophites ‡.

8th. The "nummuline wall" is paralleled by the fibrous coat which is occasionally present on the surface of grains of chondrodite §.

9th. We have shown that the relative position of two superposed acicular layers (an *upper* and an *under* "nummuline wall"), and the admitted fact of their component aciculæ often passing continuously and without interruption from one "chamber-cast" to another, to the exclusion of the "intermediate skeleton," are totally incompatible with the idea of the said

* Quart. Journ. Geol. Soc. vol. xxii. pl. xiv. figs. 1 & 2; Proceedings Royal Irish Acad. vol. x. pl. xli. figs. 1 & 2. Few figures of the "chamber-wall," published by the constructors of "*Eozoon*," afford a proper idea of its structure. We were the first to represent it in its typical condition.

† The so-called "nummuline wall" (asbestiform coat) in Dr. Carpenter's constructed representation, fig. 2, ought not to be represented in the way it is—bounded by two *continuous* lines—as it is an *integral* portion of the grains and plates of serpentine (the so-called "chamber casts"), and not a *chemically* differentiated part like the true (calcareous) wall of certain Foraminifera.

‡ Quarterly Journal Geological Society, vol. xxii. pl. xiv. fig. 4, p. 196; Proc. Royal Irish Academy, vol. x. pl. xlii. figs. 5, 6.

§ Quarterly Journal Geological Society, vol. xxii. pl. xiv. figs. 5 & 6, pp. 196 & 197.

"nummuline layers" having resulted from pseudopodial tubulation*.

10th. The so-called "stolons" and "passages of communication exactly corresponding with those described in *Cycloclypeus*" (fig. 2, *b b*) have been shown to be tabular crystals and variously formed bodies belonging to different silacid minerals, wedged crossways or obliquely in the calcitic interspaces between the grains and plates of serpentine†.

11th. The "canal-system" is composed of serpentine, malacolite, and other silacid minerals. Its typical kinds in serpentine may be traced in all stages of formation out of plates, prisms, and other solids undergoing a process of superficial decretion‡. In malacolite &c. they are made up of crystals (single or aggregated together) that have had their planes, angles, and edges rounded off, or have become further reduced by some solvent.

12th. The "canal-system," in its remarkable branching varieties, is completely paralleled by crystalline configurations in the coccolite marble of Aker, in Sweden, in the crevices of a crystal of spinel imbedded in a calcitic matrix from Amity, New York, and in a gemmiferous calcitic rock occurring in Ceylon§.

13th. The *configurations*, presumed to represent the "canal-system," are *totally without any regularity* in their form, relative size, or arrangement; and they occur independently of, and apart from, other "eozoonal features" (Amity, Boden, &c.),—facts not only demonstrating them to be purely mineral

* *Ibid.* vol. xxii. p. 191; Proc. Royal Irish Academy, vol. x. p. 517.

† Quarterly Journal Geological Society, vol. xxii. pl. xiv. figs. 10 & 11, pl. xv. fig. 15, pp. 207 & 208.

‡ Proc. Roy. Irish Acad. vol. x. pl. xliii. figs. 7 & 8, pp. 527 & 528. Speaking of the "arborescent structure" of the "canal-system," Dr. Carpenter assumes that we "maintain it to consist of mere *mineral infiltrations*"! And hence, by adopting the following mode of reasoning, he evidently feels that a decisive case has been made out against us. As the "ramifications pass across the planes of cleavage, every mineralogist will at once say that this is perfectly conclusive—against their being, by any probability, mere inorganic infiltration; that nothing but organic structures could in this manner produce a ramification of one mineral in the interior of another, a ramification of serpentine in the interior of carbonate of lime passing against its crystalline planes" ('Pharmaceutical Journal,' Feb. 11, 1871, p. 649). If this were the case, it would necessarily follow that imbedded minerals which produce "ramifications" in the "interior of calcite and passing against its crystalline planes" (as is common with native silver, prismatic pyrites, glauconite arborescences in calcite or the so-called Hislopite, the latter as made known by Mr. Carter) can be "nothing but organic structures"! It is to be regretted that Dr. Carpenter still makes use of this argument in his last communication.

§ Geological Magazine, January 1873. We have lately detected typical "canal system" in a chondrodite rock from the United States.

products, but which strike at the root of the idea that they are of organic origin.

14th. In answer to the argument that, as all the "eozoonal features" are occasionally found together in ophite, the combination must be considered a conclusive evidence of their organic origin, we have shown, from the composition, physical characters, and circumstances of occurrence and association of their component serpentine, that they represent the structural and chemical changes which are eminently and peculiarly characteristic of this mineral*. It has also been shown that the combination is parallel to a remarkable extent in chondrodite and its calcitic matrix†.

15th. The "regular alternation of lamellæ of calcareous and siliceous minerals" (respectively representing the "intermediate skeleton" and "chamber-casts") occasionally seen in ophite, and considered to be a "fundamental fact" evidencing an organic arrangement, is proved to be a *mineralogical* phenomenon by the fact that a similar alternation occurs in amphiboline-calcitic marbles and gneissose rocks‡.

16th. In order to account for certain *untoward* difficulties presented by the configurations forming the "canal-system" and the aciculæ of the "nummuline layer"—that is, when occurring as "*solid bundles*," or when they are "*closely packed*," or "*appear to be glued together*,"—Dr. Carpenter has proposed the theory that the sarcodic extensions which they are presumed to represent have been "turned into stone" (a "siliceous mineral") "by Nature's cunning" ("just as the sarcodic layer on the surface of the shell of living Foraminifers is formed by the spreading out of *coalesced* bundles of the pseudopodia that have emerged from the chamber-wall")—"by a process of chemical substitution *before* their destruction by ordinary decomposition"§. We showed this quasi-alchymical theory to be altogether unscientific‖.

17th. The "siliceous mineral" (serpentine) has been analogued with those (generalized as glauconite) forming the variously produced casts of recent and fossil Foraminifers. We have shown that the mineral silicates of "*Eozoon*" have no relation whatever to the substances composing such casts.

18th. Dr. Sterry Hunt, in order to account for the serpentine,

* Proc. Royal Irish Academy, vol. x. pp. 533, 534, 535.

† Quarterly Journal Geological Society, vol. xxii. pl. xiv. figs. 5 & 6, p. 197.

‡ Quarterly Journal Geological Society, vol. xxii. p. 210; Proc. Royal Irish Academy, vol. x. p. 523.

§ Intellectual Observer, vol. vii. uncoloured plate, fig. 2, *a*, pp. 292, 294, 296; Quarterly Journal Geological Society, vol. xxii. p. 222.

‖ Quarterly Journal Geological Society, vol. xxii. p. 202; Proc. Royal Irish Academy, vol. x. pp. 537 & 538.

Loganite, and malacolite being the presumed in-filling substances of "*Eozoon*," has propounded the "novel doctrine" that such minerals were *directly* deposited in the ocean-waters in which this "fossil" lived. We have gone over all his evidences and arguments without finding *one* to be substantiated.

19th. Having investigated the alleged cases of "chambers" and "tubes" occurring "filled with calcite," and presumed to be "a conclusive answer to" our "objections," we have shown that there are the strongest grounds for removing them from the category of reliable evidences on the side of the organic doctrine*. The Tudor specimen has been shown to be equally unavailable.

20th. The occurrence of the best-preserved specimens of "*Eozoon canadense*" in rocks that are in a "*highly crystalline condition*" (Dawson) must be accepted as a fact utterly fatal to its organic origin†.

21st. The occurrence of "eozoonal features" *solely* in crystalline or metamorphosed rocks belonging to the Laurentian, the Lower Silurian, and the Liassic systems‡ (never in *ordinary unaltered deposits* of these and the intermediate systems) must be assumed as completely demonstrating their purely mineral origin.

It is understood that a communication from Mr. Arthur Barker will appear, showing that, whatever opinion the late Professor Schultze might hold in the autumn of last year respecting "*Eozoon*," he subsequently changed it after reading our papers. As he expressed a wish to become fully acquainted with the "canal system," we were careful in sending him some instructive specimens exhibiting it in various stages of formation.

* Proceedings of the Royal Irish Academy, vol. x. pp. 582, 548; *ibid.* new ser. vol. i. p. 10. Dr. Carpenter (also Dr. Dawson) still adduces these unreliable cases, and ignores altogether the grounds on which we have considered them such.

† Dr. Carpenter, replying to the objection, as put by Mr. T. Mellard Reade, F.G.S., that "Eozoon" *only occurs in metamorphosed rocks* ('Nature,' No. 60), asserts that its "calcareous lamellæ" ("intermediate skeleton") "show less departure from the shelly texture than do the great majority of undoubted shells, corals, &c. contained in the least-altered rocks of any geological period" ('Nature,' No. 62)—forgetting that as the substance of such fossils has undergone so much change, the fact demands a vast amount of metamorphism to convert the rocks containing them ("least altered" as they may be) into the "highly crystalline condition" of "eozoonal" ophite. But Dr. Carpenter seems to misunderstand the objection altogether, as it is not based so much on the mineral structure of the "eozoonal features" as on the fact that they occur best preserved in "highly crystalline" or metamorphosed rocks.

‡ Proc. Roy. Irish Acad. vol. x., "Geological Considerations"; *ibid.* new ser. vol. i., "Isle of Skye Ophite."

MISCELLANEOUS.

Notice of new Equine Mammals from the Tertiary Formation. By Professor O. C. Marsh.

In this paper Prof. Marsh describes a very interesting series of remains of equine animals from the Tertiary deposits of the Western Territories, the fruit of the explorations of a party sent out by Yale College.

The American Eocene mammals of this group belong to a genus lately established by Prof. Marsh under the name of *Orohippus*; it is nearly allied to *Anchitherium*, but differs by "having four functional digits in the manus" and by the absence of the anteorbital fossa. The dentition is very like that of *Anchitherium*, and its formula is as follows:—

Incisors $\frac{3}{3}$, canines $\frac{1}{1}$, premolars $\frac{4}{4}$, molars $\frac{3}{3}$.

There is a long diastema; and the canine is large. The known species are *Orohippus gracilis*, Marsh, *O. pumilus*, Marsh, *O. agilis*, Marsh, and *O. major*, sp. n., all from the Eocene of Wyoming and Utah. *O. major* was about the size of a fox.

A form intermediate between *Orohippus* and *Anchitherium* is described as constituting a new genus under the name of *Miohippus annectens*. It has no anteorbital fossa; but there are only three digits in the manus. The dental formula is the same as that of *Orohippus*; and the intermediate lobes of the upper molars are more completely separated than in *Anchitherium*. *Miohippus annectens* is from the Miocene of Oregon. It was rather larger than a sheep.

Anchitherium anceps and *A. celer* are two new species. The former, about as large as a sheep, is from the Miocene of Oregon; the latter, a small species, about two thirds the size of *A. Bairdi*, is from the Miocene of Nebraska.

Equus parvulus, Marsh (Sill. Journ. xlvi. p. 374), is now referred by the author to *Protohippus*, Leidy. It is from the Pliocene deposits of Nebraska; and its remains indicate an animal about 2½ feet in height. Another species, *Protohippus avus*, sp. n., from the Pliocene of Oregon, is represented only by teeth; but these indicate such differences from the dentition of other species that the animal will probably prove to be generically distinct.

Pliohippus is a new genus allied to *Equus* and having only splint bones in place of the lateral hoofs, but closely resembling *Protohippus* in its dentition, and possessing a large anteorbital fossa. Its dental formula is as follows:—

Incisors $\frac{3}{3}$, canines $\frac{1}{1}$, premolars $\frac{4}{4}$, molars $\frac{3}{3}$.

Pliohippus pernix, sp. n., of which a considerable part of the skeleton has been exhumed from the Pliocene sands of the Niobrara river, Nebraska, was about the size of an ass. A second, and apparently somewhat larger species, *P. robustus*, sp. n., was obtained from the same locality.

The teeth of a new species of the supposed Miocene genus *An-*

chippus, *A. brevidens*, were obtained from Pliocene deposits in Oregon. Prof. Marsh thinks that Leidy's genera *Anchippus* and *Hyohippus* will probably prove to be identical.

Prof. Marsh concludes his paper with the following general remarks:—

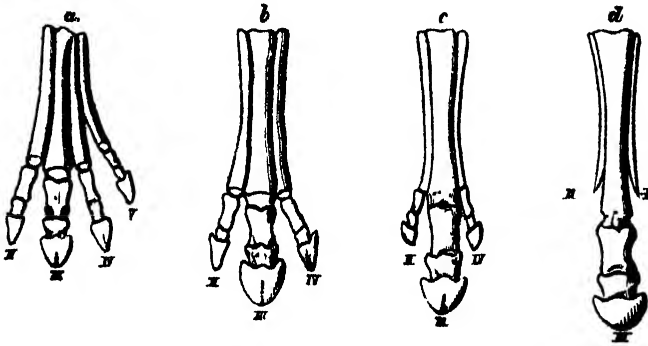
The large number of equine mammals now known from the Tertiary deposits of this country, and their regular distribution through the subdivisions of this formation, afford a good opportunity to ascertain the probable lineal descent of the modern horse. The American representative of the latter is the extinct *Equus fraternus*, Leidy, a species almost, if not entirely, identical with the Old-World *Equus caballus*, Linn., to which our recent horse belongs. Huxley has traced successfully the later genealogy of the horse through European extinct forms*; but the line in America was probably a more direct one, and the record is more complete. Taking, then, as the extremes of a series, *Orohippus agilis*, Marsh, from the Eocene, and *Equus fraternus*, Leidy, from the Quaternary, intermediate forms may be intercalated with considerable certainty from the thirty or more well-marked species that lived in the intervening periods. The natural line of descent would seem to be through the following genera:—*Orohippus* of the Eocene; *Miohippus* and *Anchitherium* of the Miocene; *Anchippus*, *Hipparion*, *Protohippus*, and *Pliohippus* of the Pliocene; and *Equus*, Quaternary and recent.

The most marked changes undergone by the successive equine genera are as follows:—1st, increase in size; 2nd, increase in speed, through concentration of limb-bones; 3rd, elongation of head and neck, and modifications of skull. The increase in size is remarkable. The Eocene *Orohippus* was about the size of a fox; *Miohippus* and *Anchitherium*, from the Miocene, were about as large as a sheep; *Hipparion* and *Pliohippus*, of the Pliocene, equalled the ass in height; while the size of the Quaternary *Equus* was fully up to that of the modern horse.

The increase of speed was equally marked, and was a direct result of the gradual modification of the limbs. The latter were slowly concentrated, by the reduction of their lateral elements and enlargement of the axial one, until the force exerted by each limb came to act directly through its axis, in the line of motion. This concentration is well seen *e. g.* in the fore limb. There was, 1st, a change in the scapula and humerus, especially in the latter, which facilitated motion in one line only; 2nd, an expansion of the radius and reduction of the ulna, until the former alone remained entire and effective; 3rd, a shortening of all the carpal bones and enlargement of the median ones, ensuring a firmer wrist; 4th, an increase in size of the third digit, at the expense of those on each side, until the former alone supported the limb. The latter change is clearly shown in the following diagram, which represents the fore feet of four typical genera in the equine series, taken in

* Anniversary Address, Geological Society of London, 1870.

succession from each of the geological periods in which this group of mammals is known to have lived:—



a. Orohippus (Eocene); *b. Miohippus* (Miocene); *c. Hipparion* (Pliocene); *d. Equus* (Quaternary).

The ancient *Orohippus* had all four digits of the manus well developed. In *Miohippus*, of the next period, the fifth toe has disappeared, or is only represented by a rudiment, and the limb is supported by the second, third, and fourth, the middle one being the largest. *Hipparion*, of the later Tertiary, still has three digits; but the third is much stouter, and the outer ones have ceased to be of use, as they do not touch the ground. In *Equus*, the last of the series, the lateral hoofs are gone, and the digits themselves are represented only by the rudimentary splint bones*. The middle, or third, digit supports the limb; and its size has increased accordingly. The corresponding changes in the posterior limb of these genera are very similar, but not so manifest, as the oldest type (*Orohippus*) had but three toes behind. An earlier ancestor of the group, perhaps in the lowest Eocene, probably had four toes on this foot, and five in front. Such a predecessor is as clearly indicated by the feet of *Orohippus*, as the latter is by its Miocene relative. A still older ancestor, possibly in the Cretaceous, doubtless had five toes in each foot, the typical number in mammals. This reduction in the number of toes may perhaps have been due to elevation of the region inhabited, which gradually led the animals to live on higher grounds, instead of the soft lowlands where a polydactyle foot would be an advantage.

The gradual elongation of the head and neck, which took place in the successive genera of this group during the Tertiary period, was a less fundamental change than that which resulted in the reduction of the limbs. The process may be said to have already begun in *Orohippus*, if we compare that form with other most nearly allied mammals. The diastoma, or "place for the bit," was well developed in both jaws even then, but increased materially

* The modern horse occasionally has one of the ancestral hooflets developed, usually on the fore foot.

in succeeding genera. The number of the teeth remained the same until the Pliocene, when the front lower premolar was lost: and subsequently the corresponding upper tooth ceased to be functionally developed. The next upper premolar, which in *Orohippus* was the smallest of the six posterior teeth, rapidly increased in size, and soon became, as in the horse, the largest of the series. The grinding-teeth at first had very short crowns, without cement, and were inserted by distinct roots. In Pliocene species the molars became longer, and were more or less coated with cement. The modern horse has extremely long grinders, without true roots, and covered with a thick external layer of cement. The canine teeth were very large in *Orohippus*, and in this genus, as well as those from the Middle Tertiary, appear to have been well developed in both sexes. In later forms these teeth declined in size, especially as the changes in the limbs afforded other facilities for defence or escape from danger. The incisors in the early forms were small, and without the characteristic pit of the modern horse. In the genera from the American Eocene and Miocene the orbit was not enclosed behind by an entire bridge of bone; and this first makes its appearance in this country in Pliocene forms. The depression in front of the orbit so characteristic of *Anchitherium* and some of the Pliocene genera is, strange to say, not seen in *Orohippus* or the later *Miohippus*, and is wanting, likewise, in existing horses. It is an interesting fact that the peculiarly equine features acquired by *Orohippus* are retained persistently throughout the entire series of succeeding forms. Such, *e. g.*, is the form of the symphysial part of the lower jaw, and also the characteristic astragalus, with its narrow, oblique, superior ridges, and its small articular facet for the cuboid.

Such is, in brief, a general outline of the more marked changes that seem to have produced in America the highly specialized modern *Equus* from his diminutive, four-toed predecessor, the Eocene *Orohippus*. The line of descent appears to have been direct; and the remains now known supply every important intermediate form. It is, of course, impossible to say with certainty through which of the three-toed genera of the Pliocene that lived together the succession came. It is not impossible that the later species, which appear generically identical, are the descendants of more distinct Pliocene types, as the persistent tendency in all the earlier forms was in the same direction. Considering the remarkable development of the group throughout the entire Tertiary period, and its existence even later, it seems very strange that none of the species should have survived, and that we are indebted for our present horse to the Old World.

Yale College, New Haven, Feb. 20th, 1874.

The young Asiatic Tapir (Rhinochœrus sumatranus). By Dr. J. E. Gray, F.R.S. &c.

The British Museum has had for many years a specimen of a young

Kuda (*Rhinochœrus*), received from Leyden under the name of *Tapirus malayanus*; and the Museum has recently received the skin of a much younger animal, which was brought to this country with the skin of an adult animal which is in the Museum. They are both said to have come from Sumatra.

These two young skins differ considerably in the markings; and as I have lately observed the same thing in the American tapirs and figured them (P. Z. S. 1872, p. 489, t. xxi. & xxii. and p. 624, t. xlv.), I have thought it desirable to describe the two specimens to draw attention to the differences, so as to learn if the young animals vary in this respect or indicate two species distinguished by the different colouring of the young.

Both specimens agree with the young West-Indian and the Peruvian tapirs in having their legs and feet with large, white, unequal-sized spots.

The larger specimen received from Leyden is more or less bleached to a brown colour. The back and sides are marked with elongate white spots placed in lines; but the spots frequently do not meet—the ends being above or below the spots behind them, and often produced beyond them. Above and below the upper lateral stripe there is also a series of very small white elongated spots on the hinder part of one side; and on the other side there are some small spots in a similar place near the shoulder. The two streaks placed on the middle of the sides of the body are broader and more continuous than the other spots; thus on one side the upper one is continuous from the shoulder to over the rump, whereas on the other side it is broken in several places. The series of spots on the middle of the back and sides of the belly are broken into numerous elongate spots of unequal length. The fore and hind legs and feet are marked with rings of roundish white spots.

The younger specimen just received very much agrees with the larger one received from Holland, but is of a blacker colour, being fresh; and it has nearly the same white streaks, but is destitute of the small spots between the streaks on the hinder parts of the sides. They both have the upper part of the head destitute of spots, and the lower part, including the cheeks and throat, with a number of similar-sized round white spots.

I am inclined to believe that the spotting or stripes of the young Sumatran tapir is liable to variation, because I observe that, although they have a similar character, their distribution varies considerably on the two sides of the same specimen.

The Habitat of Pelargopsis gigantea.
By Dr. Adolf Bernhard Meyer.

On page 123 of the present volume of the 'Annals' the habitat of *Pelargopsis gigantea* is stated as "Salok, Sulu Islands." It must be "Sulu, Sulu Islands," if the name be written after the German manner; and the neighbourhood of the town of Sulu is meant, on the island of Sulu, of the group of the Sulu Islands. The Spaniards always pronounce and write "Toló," the Dutch chiefly "Sólog" or

"Sólok," the English "Sooloo," sometimes "Sulo" &c., the Germans chiefly "Sulu;" and the name has been written in still half a dozen other ways. As the natives on the spot say "Sólog," with a soft "s," it may perhaps be recommended to write the word in this manner.

Vienna, April 4, 1874.

Contributions towards the Natural History of the Termites. By Dr. Fritz Müller.

In 1856 C. Lespès discovered that both the soldiers and the workers of *Termes lucifugus* of the Landes were represented by male and female individuals with incompletely developed sexual organs. This statement was received with some hesitation by certain naturalists, and especially by Hagen, who sought in vain for these organs in the soldiers of various species of *Termes* and *Hodotermes*. M. Fritz Müller's observations have dispelled the apparent contradictions which rendered this question obscure, and they reveal to us new facts of the highest interest in the history of the Termites.

At first M. Fritz Muller was no more fortunate than Hagen in dissecting workers or soldiers belonging to several different groups of the genus *Termes* proper. But in the workers and soldiers of the genus *Calotermes* he found the organization indicated by Lespès; and he even ascertained that in the soldiers of this group the reproductive organs are much less atrophied than in those of *Termes lucifugus*, and they acquire nearly the same development as in the winged individuals.

In the soldiers of *Calotermes canellæ* scarcely any external sexual differences are to be found; the ventral plates of the abdomen in the male and female soldiers are constructed as in the winged males. The reproductive organs of the female soldiers are scarcely distinguishable from those of the winged females, except by their slightly smaller size and the absence of the seminal receptacle. The contents of the tubes present some differences when compared with what is seen in the females. The reproductive organs of the male soldiers are exactly like those of the winged males, the testes alone being a little more slender in form.

In *Calotermes nodulosus* and *rugosus*, Hagen, the male are at once distinguished from the female soldiers by the structure of the eighth ventral arch. In the small number of female soldiers of *C. nodulosus* that he has dissected, the author did not find well characterized ova filling the whole calibre of the ovarian tubes; but he saw them in nearly all the female soldiers of *C. rugosus*.

As regards the organization of the workers of *Calotermes*, M. Müller can say nothing, for the very sufficient reason that in the five or six species of that genus which he has observed in Brazil there are no workers at all.

Two forms of nymph had often been observed in the colonies of Termites; but Lespès was the first to study and describe them carefully in *Termes lucifugus*. His "nymphs of the first form," larger than the workers and larvæ, are recognizable particularly by their

large, thick wing-sheaths, marked with lines representing veins; in these the female organs are well developed, the male organs very slightly. Lespès saw these nymphs change into perfect insects from the 15th to the 20th May. The "nymphs of the second form," less numerous than the preceding, become larger, owing to the considerable increase of the abdomen. In these the male and female organs acquire an enormous volume. Lespès supposed that these nymphs change in August into winged males and females; but he had made no direct observations upon this point.

M. F. Müller has been led to form a different conception of the functions of these different nymphs. According to him, male and female reproductive individuals exist under two different forms; some, originating from the "nymphs of the first form," acquire wings and quit the nest, a small number of them surviving and becoming kings and queens: the others, which correspond to the "nymphs of the second form," are destined never to see the light; they remain apterous, and never quit the nest where they were born. The correctness of this hypothesis, which was put forward some time ago, has been proved by this clever naturalist by direct observation. In examining the central part of the nest of a *Eutermes*, he found it surrounded by a mass of eggs, and ascertained that it did not contain a great royal chamber, but was formed by a sponge-like combination of irregular passages. In these passages were collected, in little groups, thirty-one females with short wing-sheaths, from 6 to 8 millims. in length, in the midst of which a male, of nearly the same size, was walking about. This male was a true king, with large eyes; his wings had been detached, leaving only their basal portions. "Instead of a palace containing a king, living chastely with a mate of his own condition," says the author, "I had before me a harem in which a sultan was throned in the midst of numerous mistresses."

These females, whose abdomens were agitated by undulatory contractions, like those observed in the queens, laid a great number of eggs in the course of a day; and M. Müller several times witnessed the act of oviposition.

The complemental females (*Ersatzweibchen*), as M. Müller calls them, resemble the workers in their general appearance, but they are twice as large. Their rudimentary wings are so small as not to be perceived in most of them at the first glance. In a small number of individuals these organs acquire larger dimensions, coinciding with a greater development of the mesothorax and metathorax; they then attain the middle of the second dorsal arch of the abdomen. The head closely resembles that of the workers; as in the latter, the antennæ are of fourteen joints, whilst the soldiers have thirteen and the winged individuals fifteen. The only difference between the head in these females and in the workers consists in the presence of small rounded eyes, which scarcely project. The abdomen is only moderately inflated. Each ovary, composed of about a dozen ovarian tubes, contains about six mature ova. Fifteen complemental females together did not weigh more than a single queen; the

ovaries of the thirty-one females were not more than equal in weight to those of a queen, and contained scarcely as many ova.

Many questions still remain to be solved with regard to the complemental males, the nature of the descendants produced by the different forms of sexual individuals, the causes which induce the development of one or other of these forms, &c. Numerous observations and researches will be necessary to enable us to understand thoroughly the working of these complicated societies. Nevertheless one point seems to be gained, namely the knowledge of the different forms which may be met with in a colony of Termites. M. Fritz Müller gives the following table of them:—

1. Larvæ of the first age.
   - 2. Larvæ of forms unfit for reproduction.
     - 4. Larvæ of soldiers.
       - 6. Soldiers.
     - 5. Larvæ of workers.
       - 7. Workers.
   - 3. Larvæ of forms fit for reproduction.
     - 8. Nymphs of the first form.
       - 10. Winged individuals.
         - 11. King and queen.
     - 9. Nymphs of the second form.
       - 12. Complemental males and females.

The author has made numerous observations on the structure of the nests of Termites, and gives a great number of figures which are indispensable for the proper comprehension of these constructions. We must content ourselves with mentioning the curious fact that the excrements of the Termites seem to be the materials most employed by these insects, or at least by those which burrow into trees and construct nests in the form of excrescences. If a fragment of the nest be removed, the workers come one after the other to the breach and repair it by depositing their excrements, to which certain individuals add small fragments of the broken wall. Sometimes, also, those which have nothing in the rectum disgorge the food which they have not yet digested. This latter method, probably, is not employed in time of peace; the insects, no doubt, only have recourse to it when it is necessary to repair quickly a nest broken open by some enemy.

Termes Lespèsii, F. Müller, which builds upon the ground, does not exclusively employ its excrements, although these constitute the greater part of the material of the nest; its constructions consist partly of a clayey earth. The two substances usually form successive layers, which vary in thickness and arrangement in different parts of the nest.—*Jenaische Zeitschrift*, vol. vii. (1873) pp. 333–358 & 451–463; abstract in *Bibl. Univ., Arch. des Sci. Phys. et Nat.*, March 15, 1874, pp. 254–259.

Carcinus mænas, *Pennant*.

Mr. Wood Mason exhibited a specimen of *Carcinus mænas*, Pennant, taken in 1866 or 1867 at Point de Gallo, Ceylon, by Dr. J. Anderson. Comparison of this specimen with those from the Mediterranean lately received from Prof. Cornalia, of Milan, had enabled him to be sure of the correctness of his previous identification from the published figures and descriptions. The species appeared to have an exceedingly wide distribution, being found in abundance on the shores of the British Isles and of the United States, whence it extends to the Arctic Sea, and on all the Mediterranean coasts; it has also been recorded by Heller from Rio Janeiro; and specimens will doubtless ultimately be met with in the Red Sea.—*Proceedings of the Asiatic Society of Bengal*, November 1873.

Cetacea of the North Sea and the Baltic.

Professor Malm, in his 'Zoological Observations,' gives a comparative account of fifteen specimens of the common porpoise (*Phocæna Linnæi*) occurring in the Baltic. He describes and figures a gravid female, and young, and mentions the peculiarities of each specimen. He observes that the small tubercles on the front edge of the dorsal fin, on which Dr. Gray has established *Phocæna tuberculifera*, occur very rarely among these animals; he only found it in one specimen (no. 13) out of the whole of the male and female specimens which he examined; and therefore he thinks this species is still doubtful.

Professor Mobius gives an account of a male and female grey grampus (*Grampus griseus*), which were taken on the 17th and 19th of February 1871 on the west coast of Holstein, between the Elbe and Eider. I believe this is the first time that this southern species, which sometimes visits the south coast of England, has been recorded as found so far north.

Professor Mobius records the occurrence of the following species in the Little Belt:—

Phocæna communis, F. Cuvier.
Pseudorca crassidens, Gray. November 24, 1861.
Delphinus tursio, Otho Fabricius. June 1870.
Lagenorhynchus albirostris, Gray. Winter 1851–52.
Hyperoodon rostratum, Pontop. December 3, 1807.

J. E. Gray.

On some Extinct Types of Horned Perissodactyles. By Edward D. Cope, of Philadelphia, Penn.

It is well known that the type of Mammalia of the present period, which is preeminently characterized by the presence of osseous horns, is that of the Artiodactyla Ruminantia. At the meeting of the Association of last year, held at Dubuque, I announced that the horned mammals of our Eocene period were most nearly allied to the Proboscidians. I now wish to record the fact (as I believe, for the first time) that the Perissodactyles of the intermediate formation of the

Miocene embraced several genera and species of horned giants not very unlike the *Eobasileus* and *Uintatherium* in their armature.

While exploring, in connexion with the United States Geological Survey of the Territories, I discovered a deposit of the remains of numerous individuals of the above character, which included, among other portions, crania in a good state of preservation. Most of these skulls are nearly or quite 3 feet in length, and mostly deprived of their mandibular portions; these are quite abundant in a separated condition. The crania represent at least six species, while the mandible represents a condition distinct from that of *Titanotherium* or any allied genus, viz. I. 0, C. 1, P.M. 3, M. 3. The teeth diminish rapidly in size anteriorly; and there is no diastema behind the canines, whose conic crowns do not exceed those of the premolars in length. To the genus and species thus characterized I have elsewhere given the name of *Symborodon torvus.*

One of the crania, referred to under the name of *Miobasileus ophryas,* is characterized by its strong and convex nasal bones and concave superior outline posteriorly, and by the presence of a massive horn-core on each side of the front, whose outer face is continuous with the inner wall of the orbit, as in the *Loxolophodon cornutus.* It stood above the eye in life, and diverged from its fellow so as to overhang it. In the specimen which was fully adult they were worn obtuse by use—length about 8 inches, thickness 3 inches. The molar teeth differ from those of *Titanotherium Proutii* in having cross crests extending inward from the apices of the outer chevrons, each of which dilates into a T-shape near the cones.

The third species is referred to the new genus *Symborodon,* under the name of *S. acer.* It has overhanging eyebrows and the vertex little concave; but the nasal bones are greatly strengthened, and support on each side near the apex a large curved horn-core 10 inches in length with sharply compressed apex. These horns diverge with an outward and backward curve, and when covered with their sheaths must have considerably exceeded a foot in length. This was a truly formidable monster, considerably exceeding the Indian rhinoceros in size.

The fourth species is allied to the last, and has well developed superciliary crests without horns. The latter are situated well anteriorly, and are short tubercles not more than 3 inches in height. They are directed outward, and have a truncate extremity. The type individual is of rather larger size than those of the other species. There are several crania referable to the three now named. The present one has been named *Symborodon heloceras.*

Other species, based upon crania without mandibles, were referred to the genus *Symborodon.*

These animals show true characters of the Perissodactyls in their deeply excavated palate, solid odontoid process, third trochanter of femur (which has also a pit for the round ligament), the divided superior ginglymus of the astragalus, &c.—*Read before the American Association for the Advancement of Science, Portland Meeting,* August 20, 1873.

On new Parasitic Crustacea from the N.W. Coast of America. By W. H. Dall, U. S. Coast Survey.

More than a year ago I submitted to the Academy descriptions of three new species of *Cyami* from as many species of Pacific Cetacea. On examination of a small collection of parasites in the collection of the Academy (presented by Captain C. M. Scammon, and reported to have been procured from a Pacific right whale near the island of Kadiak, Alaska, in 1873), I find that it contains two species, both apparently undescribed. It is to be presumed that each species of whale has parasites peculiar to itself; and those who have the opportunity of collecting these interesting animals should lose no opportunity of examining the rarer Cetacea, and should preserve the parasites of each species carefully by themselves. As there are many species from which no parasites have yet been collected, there are doubtless as many kinds of *Cyami* which are still unknown.

The species described on pp. 281–283, vol. iv. of the Academy's 'Proceedings' ('Annals,' 1873, vol. xi. pp. 157, 158), have been well figured on plate x. of Captain Scammon's 'Marine Mammals of the N.W. Coast of America;' and, in default of a figure of the present species, I have preferred to give a comparative diagnosis by which they may be more readily distinguished from the figured and other described species.

Cyamus tentator, n. sp.

Species in size and general form resembling *C. Scammoni*, Dall (Scammon, *loc. cit.* pl. x. fig. 2), of a pale waxy yellow, with the tips of the branchiæ purplish. It differs from *C. Scammoni* in the following particulars:—Head proportionally smaller, not constricted behind the eyes, terminating in a point in the median line behind, which point overlaps a median channel in the body-segment. Second pair of antennæ proportionally much longer, equalling twice the length of the head. Second pair of hands with two sharp spike-like tubercles in place of the two rather short and blunt tubercles of *C. Scammoni*; hands otherwise very similar. Second segment with a broad channel in the median line, widening backward from the head and rather shallow; third segment not rounded at its outer ends, but furnished with very prominent knobs at the anterior and posterior corners on each side; the outer edges of the fourth segment are also knobbed before and behind, but the anterior knobs are less prominent. The branchiæ are not spirally twisted, but are straight, laterally extended cylinders, nearly as long as the width of the segment to which they are attached. There are two pairs on each side of the third and fourth segments in the male. The upper pair on each side are not of equal length, as in *C. Scammoni*, but the inferior branchia of this pair is much shorter than the other; both are straight or slightly curved upward and forward. The lower pair exist only in the males; they are very slender and filiform, and quite short; in the female they seem to be changed into pouches for the

development of the ova. Posterior part of the body as in *C. Scammoni*, but there are no serrations on the anterior edge of the seventh segment. Length of largest specimen 0·8 inch.

Domicile on *Balæna Sieboldii*, Gray; North Pacific Ocean.

This is readily distinguished from *C. mysticeti*, Dall, by its spiked "hands" and knobby branchial segments, and from *C. Scammoni* by its straight unequal branchiæ, long antennæ, knobs, and the shape of the head.

Cyamus gracilis, n. sp.

This species is of a pale waxen yellow, of elongated and slender form, and small and slender limbs. It more nearly resembles *C. suffusus*, Dall (Scammon, *loc. cit.* pl. x. fig. 3), than any of the other described species. It differs from that species in the following particulars:—It is smaller, the largest specimen measuring only 0·5 of an inch in length. It wants the purple colour, and is more compact and solid. The second pair of antennæ are much shorter, being only equal to the first segment and half of the next segment of the corresponding members in *C. suffusus*. The branchiæ, though similar, are proportionally one third shorter. The posterior limbs are shorter and much more weak and slender than in *C. suffusus*. The first pair of "hands" are slenderly pyriform instead of quadrate; the second pair are simple, without the tubercles between the articulation of the limb and the "finger;" or, at most, in the largest specimens the termination of the hand under the articulation of the hook or finger is slightly produced into a point. The head is shorter, subtriangular, instead of elongated. Lastly the segments of the body are more or less closely appressed against each other before and behind, instead of being laterally attenuated and separated as in *C. suffusus*; they are also proportionally less wide from side to side than in *C. suffusus*.

Habitat, with the last.

The prominent features of this species are its slender and compact form, short antennæ, and weak and inconspicuous posterior limbs.

Captain T. W. Williams brought down from the Arctic Ocean in 1873 some parasites from the walrus, which he presented to the Academy. These parasites are of a very dark brown colour, almost perfectly round in shape, with an indistinctly segmented abdomen somewhat roughened with short hairs, three pairs of short bristly legs, a distinct but small throat, and very small and short head. There is one pair of short stout antennæ with four joints; the mouth is suctorial. There are no other appendages to the abdomen or head. The want of books of reference prevents my being able to refer these creatures to their proper generic position; and it would be, in any case, unadvisable to describe them as new, as parasites from the walrus of the North Sea have recently been described by a Swedish naturalist, and they may be identical with the present form.—*Proceedings of the California Academy of Sciences*, March 3, 1874.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

No. 78. JUNE 1874.

LVII.—*On a Land-Nemertean found in the Bermudas.* By R. v. Willemoes-Suhm, Ph.D., Naturalist to the 'Challenger' Expedition.

[Plate XVII.]

During our stay in the Bermudas I frequently visited the mangrove-swamps in Hungry Bay, Bermuda Island, in order to observe and collect the land-crabs. I then also turned over the stones which are scattered on drier land, where the cedar trees begin to dry, and looked out for worms. *Lumbricus* was very common there; but in the moist earth in which I found them I soon also observed long slimy animals, which were evidently not annelids: having brought them on board, I found them to be Nemerteans. I then returned to the spot and collected a good many more of them, which I kept in a bottle with moist earth, and was then able to observe at leisure during our cruise to the Azores.

The largest of these worms have a length of 35 millims. by 2 millims. in width. They are of a milky white colour. Their movements are slow, and sometimes caterpillar-like; they shoot out their long proboscis, fix it at some distant point, to which it adheres by means of its papillæ, and draw their body after them. Their *skin* is filled with rod-like bodies, as described by Max Schultze and others, and is covered on the outside all over with cilia. In the front we find two pairs of *eyes*, one of them near the entrance of the proboscis, the other smaller one further out; they consist of a fine granulated pigment imbedded in a colourless substance, which holds these

granules together, in which, however, a regular lens could not be observed. Underneath these eyes is seen the prominent *centre of the nervous system* (Pl. XVII. fig. 1, *g*): it consists of two lobes, and a ring which connects them and encircles the proboscis. From these lobes depart the two lateral nerves (fig. 1, *n*), and some other cephalic nerves, which were not quite clearly visible. In most genera of the Tremacephalidæ the *cephalic fissures* or ciliated sacs are easily to be seen; here they are either very small or wanting entirely. Sometimes a folding of the skin seemed to indicate their presence; but in the contractile bodies of these worms it is very difficult to say whether you have a small cephalic fissure or a folding of the skin before you.

Underneath the ganglion, on the under surface is the semicircular opening of the *mouth* (fig. 1, *o*), leading into an intestinal tube (fig. 1, *i*), which runs through the whole length of the animal without showing any thing particular, and is terminated by an anus (fig. 1, *a*). It is covered above by a long *proboscis* (fig. 1, pr^1–pr^4), which opens at the front and ends in the posterior part of the body, where its thin termination is attached to its walls. This proboscis is divided into two portions—the papilligerous part, and the glandular part. At the bottom of the former we find a peculiar spine, the top of which is supposed to be renewed from the smaller spines which are in store in two vesicles on each side of it. This spine is remarkable, because it differs in form according to the sex of its owner. In the male it has a rounded base and is pear-shaped (fig. 2, pr^3), while in the female the base has sharpened angles (fig. 3, pr^3). I do not think that such sexual differences have hitherto been observed in Nemerteans.

The ovaries and testes are, as usual, situated between the intestine and the walls of the body. They did not present any thing peculiar, and are not represented in the diagrammatic figure I have often referred to. Probably the animal is viviparous, as is *Tetrastemma obscurum* from the Baltic; but on this subject nothing has been observed.

Though I have not been able to demonstrate the cephalic sacs, which are peculiar to most of the Tremacephalidæ hitherto described, I think there can be hardly any doubt that this worm belongs to that family; for some marine species of the genus *Tetrastemma* bear a most close resemblance to it. I therefore think I can safely call it by this latter generic name, and establish for it the specific name of *agricola*, as there is probably no described marine species of *Tetrastemma* with which it could be identified.

I, however, do not attach much importance to this point, as

the object of these lines is only to show that in America also land-Nemerteans exist. Hitherto they were only known from the Pelew Islands, where Semper has found another Tremacephalid, to which he has given the name of *Geonemertes pelæensis.* I think it is highly probable that land-Nemerteans exist to a greater extent in tropical countries than has hitherto been supposed, and that, from their hidden life and the impossibility of preserving them, they have hitherto escaped the attention of travelling naturalists. Especially in such islands as the Bermudas, where the earth of the lower grounds contains a great deal of salt, it may easily be imagined how marine animals have taken to terrestrial habits; and it was interesting for me to see that our *Tetrastemma* when put into salt water would live there for twenty-four hours, but when put into fresh water died after a few hours time. Fresh water, however, poured over the earth which contained them did not damage them in the least.

I may here also add that on our cruise from the Bermudas to the Azores I found *parasitical Nemerteans* on *Nautilograpsus minutus*, one of the gulf-weed crabs. They were small brownish animals, and occupied especially the underside of the crab, under the abdomen of which I found most of them. They did not exceed the length of 2 millims.; and in none of them could I see genital organs. In fig. 4 I have figured one of these small parasites, which probably also belong to the genus *Tetrastemma*, though the second pair of eyes is only punctiform, situated on both sides of the proboscis. Nervous system and digestive apparatus do not present any thing particular; the proboscis (fig. 4, pr^1–pr^3) is remarkable for its shortness.

I do not think that these worms attain their full size on the crab; but believe them to be young parasitical stages of some Nemertean which possibly lives on the gulf-weed. In this group of worms no case of parasitism has, as far as I know, been mentioned before.

H.M.S. 'Challenger,' Cape Town,
November 1873.

EXPLANATION OF PLATE XVII.

Fig. 1. Young male of *Tetrastemma agricola.* Low power. pr^1–pr^4, successive portions of the proboscis—pr^1 entrance, pr^2 papillar portion, pr^3 pouch of stylets, pr^4 glandular portion; *ca*, muscular entrance of the glandular portion; *o*, mouth; *i*, intestine; *a*, anus; *g*, ganglion; *n*, lateral nerves.

Fig. 2. Part of the male's proboscis. The same letters as above. High power.

Fig. 3. Part of the female's proboscis. High power.

Fig. 4. Young parasitical *Tetrastemma* from *Nautilograpsus minutus.* High power. Letters as above.

LVIII.—*Additions to the Australian* Curculionidæ. Part VII. By Francis P. Pascoe, F.L.S. &c.

PSYDESTIS.

Rostrum breviusculum, cylindricum, validum, subarcuatum; *scrobes* submedianæ, ad oculos currentes. *Oculi* rotundati, tenuiter granulati, antice modice approximati. *Scapus* oculum attingens; *funiculus* 7-articulatus, articulis duobus basalibus longiusculis, cæteris brevibus; *clava* distincta. *Prothorax* transversus, utrinque ampliatus, basi bisinuatus, lobis ocularibus obsoletis. *Elytra* cordata, convexa. *Coxæ* anticæ haud contiguæ; *femora* crassa, dentata; *tibiæ* breves, compressæ, intus bisinuatæ, extus rectæ; *tarsi* articulo ultimo tenuato. *Mesosternum* depressum, valde transversum. *Abdomen* segmento secundo brevi.

Allied to *Melanterius*; but differs in its short stout rostrum, absence of ocular lobes, and short second segment of the abdomen. There is also an evident affinity between this genus and *Diethusa*, *Enide*, and *Lybæba*—genera referred by me to the Erirhininæ, from their apparent connexion with *Gerynassa*, *Erytenna*, &c.; but I think now that they will be better placed in the neighbourhood of *Melanterius*.

Psydestis affluens.

P. obovata, valde convexa, fusca, sat dense fulvo-squamosa, cinnamomeo plagiatim vel maculatim varia; rostro capite sesquilongiore, apice rufescenti et leviter punctulato; antennis piceo-testaceis, clava infuscata; prothorace apice quam basi triplo angustiore, dorso bi- vel trinotato; elytris sulcatis, interstitiis carinatis, humeris obliquis, apicibus rotundatis. Long. 2¼ lin.

Hab. West Australia.

Poropterus tetricus.

P. sat late ovatus, niger, fusco-squamosus; capite inter oculos transverse depresso; rostro subbrevi, valido, punctis magnis raris (apice solo excepto) rude impresso; funiculo articulis duobus basalibus fere æqualibus; prothorace transverso, supra paulo depresso, apice integro, in medio canaliculato, utrinque angulato-

producto, basi profunde bisinuato; elytris modice convexis, ampliatis, apicem versus sat fortiter constrictis, apice ipso rotundato, supra irregulariter nigro-fasciculatis, squamis erectis claviformibus adspersis; abdomine segmentis duobus basalibus peramplis; tarsis posticis articulo penultimo minus bilobo. Long. 6 lin.

Hab. Gayndah.

In outline like *P. innominatus* (*antè*, vol. xi. p. 197), but proportionally broader, the prothorax strongly and angularly expanded at the sides, the rostrum stout, comparatively short, and roughly punctured, and the two basal joints of the funicle of nearly equal size, the second perhaps a trifle longer. The fascicles on the elytra are disposed nearly as in *P. innominatus*, but are less distinctly limited.

Scolyphrus.

Rostrum subrobustum, arcuatum; *scrobes* submedianæ, obliquæ, ampliatæ. *Scapus* in medio rostri insertus; *funiculus* 7-articulatus, articulis duobus basalibus longioribus, ultimo in clavam continuato. *Prothorax* ad latera compressus, supra parum convexus, apice productus. *Elytra* ampla. *Femora* parum incrassata, mutica; *tibiæ* rectæ; *tarsi* lineares, infra haud spongiosi. *Abdomen* segmentis duobus basalibus peramplis.

Differentiated from *Poropterus* by its narrow tarsi, the third joint not being bilobed, canaliculate beneath, with the edges fringed with silky hairs. *Agenopus*, also having linear tarsi, has the three intermediate segments of the abdomen equal or nearly so. The species described below is a rough-looking insect, with a deep prothorax, the sides below the line of the back compressed and nearly vertical.

Scolyphrus obesus.

S. niger, opacus, squamulis crassis griseis adspersus; rostro prothorace breviore, sat sparse punctulato; oculis infra sensim angustioribus; funiculo articulo secundo quam primo longiore; clava parva; prothorace longitudine latitudini æquali, dorso in medio longitudinaliter depresso, apice angusto, ante medium fortiter rotundato, dein ad basin parum angustiore; elytris peramplis, late ovatis, sat fortiter convexis, basi grosse, versus medium sensim minus punctatis, apice rotundatis. Long. 8 lin.

Hab. Queensland (Port Denison).

Petosiris annulipes.

P. subovalis, supra modice convexus, fuscus, squamis erectis concoloribus vage adspersus; capite inter oculos longitudinaliter excavato; rostro modice elongato; antennis subferrugineis; funiculo articulis duobus basalibus æqualibus, quatuor sequentibus breviusculis, ultimo valde ampliato; prothorace transverso, lateribus a

modio parallelis, supra tuberculis quatuor mediocribus transversim sitis; elytris subcordiformibus, humeris obliquis, tunc ad medium parallelis, postice cito angustioribus, apice rotundatis, subseriatim fortiter punctato-impressis, interstitiis 3°, 5°, 7° tuberculato-fasciculatis, basi utrinque callosis; femoribus tibiisque subalbido-annulatis, his minus elongatis. Long. 4 lin.

Hab. New South Wales (Armadale).

The elytra are longer and somewhat differently formed than in *P. cordipennis*, having coarsely impressed punctures, and with a marked callosity on each side at the base. The femora have two and the tibiæ one well-defined whitish ring on each of them respectively.

Drassicus infaustus.

D. sat late ovatus, niger, opacus, squamis concoloribus rude vestitus; rostro rugoso-punctato; antennis ferrugineis, apicem versus infuscatis; scapo brevi, pone medium rostri inserto; funiculo articulis duobus basalibus longitudine æqualibus; prothorace subtransverso, apice paulo producto, pone apicem vix constricto, in medio utrinque rotundato, modice confertim punctato; elytris subgloboso-cordatis, basi prothorace haud latioribus, sulcato-punctatis, interstitiis convexis, indistincte griseo-maculatis; femoribus infra mediocriter dentatis; tibiis brevibus. Long. 2¾ lin.

Hab. Queensland (Wide Bay).

In the two normal species of *Drassicus* the apex of the prothorax forms a sort of hood over the head; in the above it is of the ordinary character; but although this and some minor points leave a sort of gap between them, there seems nothing of structural importance to show that they are not congeneric.

Imaliodes scrofa.

I. late ovatus, fuscus, omnino dense griseo-squamosus, supra squamis majoribus parce, infra pedibusque minus adspersus; rostro prothorace paulo breviore, apicem versus sensim minus squamoso; antennis subferrugineis; funiculo articulis duobus basalibus longiusculis, 3° 4° gradatim brevioribus, tribus ultimis turbinatis; clava distincta; prothorace subtransverso, basi quam apice duplo latiore, bisinuato, in medio rotundato; elytris utrinque rotundatis, postice declivibus, sulcato-punctatis, insterstitiis alternis magis elevatis; femoribus tibiisque modice incrassatis. Long. 4 lin.

Hab. Albany.

Differs from the normal forms in its longer rostrum, the pectoral canal terminating a little more between the intermediate coxæ, the club not closely connected to the funicle, and the legs less robust. In habit they are much alike.

Acalles delirus.

A. ovalis, niger, opacus, supra squamis erectis adspersus; rostro antice punctis magnis in seriebus quatuor dispositis; antennis ferrugineis; clava ovata, obtusa; prothorace longitudine latitudini æquali, utrinque fortiter rotundato, pone apicem haud constricto, apice ipso angustissimo, supra rude foveato, interspatiis nitide granulatis, in medio linea elevata nitida instructo; elytris prothorace haud latioribus, subseriatim rugoso-punctatis, interstitiis convexis, granulis nitidis, plurimis squamam albam emittentibus, obsitis; tibiis anticis haud, cæteris paulo compressis. Long. $2\frac{3}{4}$ lin.

Hab. Rockhampton.

The species here referred to *Acalles* appear to me to differ in no respect generically from such of the European species as I have examined. They are all dark brown or black, with few scales; and these, arising singly from punctures, are frequently more or less erect and claviform or spatulate—common characters among the Cryptorhynchinæ. The rostrum is comparatively stout, as a rule perhaps a little shorter than the prothorax, and always very perceptibly broader towards the apex; the first two abdominal segments are large and pitted with very coarse punctures, each bearing a broad flat, or sometimes a narrow curved, scale. *Curculio stupidus*, Fab. (Ent. Syst. ii. p. 432), from the type in the British Museum, appears to be referable to *Acalles*; but its tibiæ are much longer than usual, and its posterior femora are toothed beneath; in other respects it is like *A. bisignatus*, but considerably larger. *Curculio luridus*, Fab. (Ent. Syst. ii. p. 431), placed in *Acalles* in the Munich Catalogue, is a *Poropterus*. *Acalles obesus*, Boisd. (Astrol. ii. p. 438, *Tylodes*), is probably not Australian: Boisduval gives no habitat; but I have it from Gagie and Ceram, where it was found by Mr. Wallace.

The following table will give an idea of the diagnostic characters of the species here described:—

Elytra granulate.
- **Rostrum punctured in four rows** .... *delirus.*
- **Rostrum irregularly punctured.**
  - **Funicle scarcely longer than the scape** .... *bisignatus.*
  - **Funicle twice as long as the scape** .... *cribricollis.*

Elytra not granulate.
- **Prothorax contracted behind the apex.**
  - **Base of elytra not or scarcely broader than the prothorax.**
    - **Rostrum more or less closely and coarsely punctured.**
      - **Rostrum less closely punctured towards the apex.**
        - **Prothorax finely punctured** .... *perditus.*
        - **Prothorax coarsely punctured**................ *foraminosus.*
      - **Rostrum very closely punctured throughout** .... *nucleatus.*
    - **Rostrum not closely or coarsely punctured** .... *memnonius.*
  - **Base of the elytra manifestly broader than the prothorax** *distans.*
- **Prothorax not contracted behind the apex** .... *expletus.*

Acalles nucleatus.

A. ovatus, niger, opacus, squamis albidis adspersus; rostro valido, punctis majusculis, singulis squama minuta instructis, creberrime impresso; fronte capitis leviter punctata; antennis nitide ferrugineis; funiculo in clavam continuato; prothorace modice transverso, ante medium magis rotundato, confertim fortiter punctato; elytris subcordatis, sulcato-punctatis, punctis foveiformibus, approximatis, interstitiis convexis, subangustis, leviter punctatis; tibiis brevibus, posticis vix longioribus. Long. 2⅔ lin.

Hab. Adelaide.

The rostrum is very closely and coarsely punctured even to the apex.

Acalles distans.

A. sat late ovatus, niger, subnitidus; rostro punctis magnis irregulariter adsperso; antennis nitide ferrugineis; clava ovata, obtusa; prothorace transverso, utrinque ampliato-rotundato, punctis mediocribus sat crebre impresso; elytris substriato-foveatis, foveis magnis, remotis, interstitiis subplanatis, granulis parvis depressis instructis; pedibus piceis; tibiis brevibus, compressis. Long. 2–2½ lin.

Hab. Swan River.

A broad species, almost elliptic in outline, with the elytra very obviously broader at the base than the prothorax. The rostrum in one of my specimens, owing to the irregularity of the punctuation at about the middle of its length, has three smooth oblong patches.

Acalles cribricollis.

A. ovatus, niger, subnitidus; rostro sublineatim sulcato-punctato, punctis oblongis, nonnullis confluentibus; antennis subferrugineis; funiculo quam scapo duplo longiore; prothorace subtransverso, crebre fortiter punctato, in singulis punctis squama elongata; elytris cordatis, fortiter sulcato-punctatis, punctis ampliatis, singulis squama alba rotundata instructis, interstitiis modice convexis, granulis parvis uniseriatim obsitis; pedibus castaneis, sat vage punctatis; tibiis breviusculis. Long. 2¼ lin.

Hab. Champion Bay.

The granules on the elytra are very small, but under a powerful lens very distinct; the punctures on the rostrum are mostly placed in grooves having smooth, slightly irregular lines between them.

Acalles bisignatus.

A. late ovalis, niger, opacus, squamulis griseis parvis adspersus;

rostro punctis magnis sat crebre irrorato; antennis subferrugineis, nitidis; clava elongata acuminata; prothorace transverso, utrinque valde ampliato-rotundato, apice fortiter constricto, subreticulato-punctato, in medio dorsi foveis duabus, transversim sitis, squamulis minutis albis repletis; elytris subcordatis, basi truncatis, ad angulos humerales dentato-projectis, sulcato-foveatis, interstitiis irregulariter granulatis; abdomine segmentis duobus basalibus punctis permagnis, squamositate griseis indutis, notatis; tibiis vix compressis, magis, præsertim posticis, elongatis. Long. 3⅜ lin.

Hab. Gayndah.

Easily known from the other species here described by its prothorax marked with two shallow impressions or foveæ filled with white scales.

Acalles perditus.

A. ovatus, niger, vix nitidus, squamis albidis rarissime adspersus; capitis fronte tenuiter vage punctata; rostro sat grosse crebre, apicem versus subconfertim punctato; antennis subferrugineis, nitidis; funiculo scapo fere longitudine æquali; clava breviter ovata; prothorace transverso, utrinque ante medium rotundato, apice constricto, fortiter creberrime punctato; elytris oblongo-cordatis, in medio quam prothorace latioribus, sulcato-foveatis, foveis modice approximatis, interstitiis convexis, leviter punctatis, maculis paucis albis, e squamis condensatis formatis, quarum duabus basalibus conspicue notatis, adspersis; tibiis, præsertim anticis intermediisque perbrevibus. Long. 2–2¼ lin.

Hab. Melbourne; Albany.

The spots will probably be only found in fresh specimens.

Acalles memnonius.

A. ovatus, niger, subnitidus, rostro pedibusque castaneis, squamis albis rarissime adspersus; rostro breviusculo, modice punctato, in medio lævigato; antennis subferrugineis; funiculo articulis ultimis valde transversis; clava ovata; prothorace longitudine latitudini æquali, pone apicem utrinque modice rotundato, grosse reticulato-punctato; elytris cordiformibus, sulcato-foveatis, foveis majusculis, subquadratis, singulatim squama parva albida instructis; corpore infra pedibusque squamulis albis adspersis; tibiis brevibus, haud compressis. Long. 2¼–2½ lin.

Hab. King George's Sound.

This species is clearly differentiated by its rostrum, with oblong scattered punctures of intermediate size.

Acalles foraminosus.

A. ovatus, niger, nitidus, rostro basi capiteque grosse reticulato-

punctatis, punctis versus apicem magis adsperso; antennis subferrugineis; funiculo quam scapo sesquilongiore; prothorace subtransverso fortissime crebre punctato, ad apicem punctis minoribus; elytris cordatis, fortiter sulcato-punctatis, punctis magnis subquadratis, interstitiis convexis, squamulis albis adpressis irroratis; corpore infra pedibusque squamulis albis elongatis adsperso; tibiis brevibus. Long. 2¼ lin.

Hab. Albany.

Remarkable for the large, deep, and closely ranged punctuation of the prothorax.

Acalles expletus.

A. **ovatus, fusco-piceus, grisco-squamosus; rostro longiore, sat sparse punctulato, in medio lævigato; antennis subferrugineis, funiculo articulis longioribus; prothorace longitudine latitudini æquali, utrinque rotundato, apice haud constricto, grosse reticulato-punctato, in medio linea elevata instructo; elytris subcordatis, basi prothorace haud latioribus, squamis griseis adpressis sejunctim vestitis, sulcato-punctatis, interstitiis latis, convexis; tibiis brevibus. Long. 2¼ lin.**

Hab. Rockhampton.

This species has a prothorax without any trace of the constriction behind the apex which is a character of most of the species of this extensive genus.

Euoropis.

Ab *Acalle* differt *tibiis* extus prope basin dente angulato instructis.

This character of the tibiæ is seen also in *Empleurus* and one or two other allied genera. It is perhaps of no great importance; but in a large genus like *Acalles* it is very desirable not to admit any species having a structural peculiarity at variance with its normal forms. The type of the genus is in habit like some of the preceding; but the sculpture is somewhat different:—small deep punctures on the prothorax, each filled with a white scale not rising above the surrounding level; and on the elytra fine punctured striæ, with flat, broad interstices, having only very fine traces of punctures.

Euoropis castanea.

E. **ovata, subnitida, fusca, albo-squamosa, elytris pedibusque castaneis; capite crebre punctulato; rostro castaneo, basi longitudinaliter gibboso, sat denso squamoso, versus apicem vage punctulato; antennis subferrugineis; scapo fere in medio rostri inserto; funiculo articulis duobus basalibus cæteris conjunctim paulo lon-**

gioribus; prothorace subconico, utrinque rotundato, punctis parvis, singulis squama repletis, confertim impresso; elytris subovatis, prothorace manifeste latioribus, basi fortiter bisinuatis, apice obtuse rotundatis, anguste striato-punctatis, striis squamulis piliformibus albis uniseriatim adpressis, interstitiis latis planatis, obsolete punctulatis; corpore infra, femoribus subtus tibiisque sat dense albo-squamosis, his brevibus, haud compressis, posticis paulo longioribus. Long. 3 lin.

Hab. Swan River.

EMBAPHIODES.

Rostrum tenuatum, paulo depressum, arcuatum; *scrobes* postmedianæ, ad oculum currentes. *Oculi* rotundati, subtenuiter granulati. *Scapus* oculum attingens; *funiculus* 7-articulatus, articulis quatuor primis elongatis, cæteris brevibus; *clava* oblonga, distincta. *Prothorax* subconicus, supra depressus, apice productus, lobis ocularibus prominulis. *Scutellum* parvum. *Elytra* cuneiformia, prothorace haud latiora, supra planata, margine exteriore carinata, epipleuris distinctis, verticalibus. *Rima* pectoralis inter coxas intermedias extensa, apice cavernosa. *Pedes* mediocres; *femora* postica elongata, subtus dentato-angulata, antica et intermedia mutica, sublinearia; *tibiæ* flexuosæ, compressæ; *tarsi* articulo basali modice elongato, penultimo fortiter bilobo. *Abdomen* segmentis duobus basalibus ampliatis.

A singular genus belonging to the *Tylodes* group, but, like its neighbours *Plagiocorynus* and *Glochinorhinus*, with no obvious allies. The upper surface of the narrow wedge-shaped elytra is slightly concave and bounded at the side, except towards the apex, by a very strong carina, from which the epipleura descends almost vertically; that it is not quite vertical is owing to a marked concavity below the carina; the epipleura itself constitutes the largest part of each elytron. Although this style is common among the Tenebrionidæ, I do not recollect any other instance of it among the Curculionidæ, except, to a certain extent, in *Hybomorphus* and a few others.

Embaphiodes pyxidatus.

E. fuscus, sordide griseo-squamosus; rostro quam capite prothoraceque conjunctim longiore, nitide castaneo, (basi excepta) esquamoso; antennis nitidis, funiculo articulo secundo quam primo sesquilongiore; prothorace pone apicem lunato-impresso, utrinque rotundato, crebre punctato, punctis singulis squamam gerentibus; elytris sejunctim squamosis, punctis squamigeris instructis, in dorso singulorum seriebus quatuor dispositis; corpore infra pedibusque dense squamulosis, squamis majoribus dispersis. Long. 4 lin.

Hab. Lord Howe Island.

LIX.—*On the Invertebrate Marine Fauna and Fishes of St. Andrews.* By W. C. M'Intosh.

[Continued from p. 357.]

Class GASTEROPODA.

Order I. Cyclobranchiata.

Fam. Chitonidæ, Guilding.

Genus Chiton, L.

Chiton fascicularis, L. Jeffreys, Brit. Moll. iii. p. 211, v. pl. 55. f. 3.

Abundant under stones between tide-marks. This species, like the limpet, forms considerable cavities in sandstone, so that specimens become almost immersed.

Chiton cinereus, L. *Op. cit.* iii. p. 218, v. pl. 55. f. 2.

Common in deep water, and in the stomachs of the cod, haddock, and flounder.

Chiton marginatus, Pennant. *Op. cit.* iii. p. 221, v. pl. 56. f. 5.

Frequent under stones between tide-marks.

Chiton ruber, Lowe. *Op. cit.* iii. p. 224, v. pl. 56. f. 4.

Occasionally between tide-marks at the East Rocks.

Chiton lævis (Pennant), Mont. *Op. cit.* iii. p. 226, v. pl. 56. f. 6.

Under stones at the verge of extreme low water during spring tides. Rare; but the examples are large.

Order II. Pectinibranchiata.

Fam. 1. Patellidæ, Guilding.

Genus 1. Patella, Lister.

Patella vulgata, L., and var. *depressa*. *Op. cit.* iii. p. 236, v. pl. 57.

Common everywhere; occasionally eaten. The soft shale and sandstone are extensively pitted by this form.

Genus 2. Helcion, De Montfort.

Helcion pellucidum, L. *Op. cit.* iii. p. 242, v. pl. 58. f. 1 & 2.

Abundant on the blades of the tangles; while var. *lævis* occurs in hollows at the bases of the stems.

Genus 3. TECTURA, Cuvier.

Tectura testudinalis, Müller. *Op. cit.* iii. p. 246, v. pl. 58. f. 3.

Common under stones near low-water mark.

Tectura virginea, Müller. *Op. cit.* iii. p. 248, v. pl. 58. f. 4.

Under stones near low-water mark; nearly as common as the foregoing.

Tectura fulva, Müller. *Op. cit.* iii. p. 250, v. pl. 58. f. 5.

A single specimen on the West Sands after a storm.

Fam. 2. **Fissurellidæ**, Fleming.

Genus 2. EMARGINULA, Lamarck.

Emarginula fissura, L. *Op. cit.* iii. p. 259, v. pl. 59. f. 2.

Not uncommon in deep water; and worn specimens amongst the shell-débris on sands.

Fam. 3. **Capulidæ**, Fleming.

Genus CAPULUS, De Montfort.

Capulus ungaricus, L. *Op. cit.* iii. p. 269, v. pl. 59. f. 6.

Frequent in deep water, and often brought in by the fishing-boats.

Fam. 7. **Trochidæ**, D'Orbigny.

Genus 2. TROCHUS, Rondeletius.

Trochus tumidus, Mont. *Op. cit.* iii. p. 307, v. pl. 62. f. 2.

Common on hard ground in the bay, in the stomach of the cod and haddock, and on the West Sands after storms.

Trochus cinerarius, L. *Op. cit.* iii. p. 309, v. pl. 62. f. 3.

In great abundance on stones and rocks between and beyond tide-marks.

Trochus zizyphinus, L. *Op. cit.* iii. p. 330, v. pl. 63. f. 6.

Not uncommon in deep water and on the beach after storms; rarely met with at extreme low water at the East Rocks. Var. *Lyonsii* is occasionally seen.

Fam. 9. Littorinidæ, Gray.

Genus 1. Lacuna, Turton.

Lacuna crassior, Mont. *Op. cit.* iii. p. 344, v. pl. 64. f. 2.

From tangle-roots and in old shells in the laminarian region, and from deep water; not rare.

Lacuna divaricata, Fab. *Op. cit.* iii. p. 346, v. pl. 64. f. 3.

On Fuci and laminarian blades at and beyond low-water mark. The colourless variety is not uncommon; and the same may be said of var. *quadrifasciata*.

Lacuna puteolus, Turton. *Op. cit.* iii. p. 348, v. pl. 64. f. 4.

With the former at low-water mark; less common than the foregoing.

Lacuna pallidula, Da Costa. *Op. cit.* iii. p. 351, v. pl. 64. f. 5 & 5 *a*.

On the West Sands after storms, and from the laminarian region.

Genus 2. Littorina, Férussac.

Littorina obtusata, L. *Op. cit.* iii. p. 356, v. pl. 65. f. 1 & 1 *a*.

Very common (with varieties) on stones and rocks between tide-marks.

Littorina rudis, Maton. *Op. cit.* iii. p. 364, v. pl. 65. f. 3, 3 *a*, & 3 *b*.

Abundant on the rocks near high-water mark.

Littorina litorea, L. *Op. cit.* iii. p. 368, v. pl. 65. f. 5 & 5 *a*.

Between tide-marks in vast numbers. Often eaten.

Genus 3. Rissoa, Fréminville.

Rissoa parva, Da Costa. *Op. cit.* iv. p. 23, v. pl. 67. f. 3 & 4.

In great numbers on the seaweeds in the laminarian region all round, especially off the East Rocks. Var. *interrupta* is also common in shell-sand.

Rissoa striata, Adams. *Op. cit.* iv. p. 37, v. pl. 68. f. 2.

Common under stones between tide-marks. The var. *arctica* is the prevailing form.

Rissoa soluta, Philippi. *Op. cit.* iv. p. 45, v. pl. 68. f. 7.
Occasionally in deep water and in shell-sand.

Rissoa semistriata, Mont. *Op. cit.* iv. p. 46, v. pl. 68. f. 8.
From deep water and in shell-sand; not common.

Genus 4. HYDROBIA, Hartmann.

Hydrobia ulvæ, Pennant. *Op. cit.* iv. p. 52, v. pl. 69. f. 1.
In great abundance in the brackish pools near the mouth of the river Eden.

Fam. 11. **Skeneidæ**, Clark.

Genus 1. SKENEA, Fleming.

Skenea planorbis, Fab. *Op. cit.* iv. p. 65, v. pl. 70. f. 1.
Common in rock-pools amongst *Ceramium* and other algæ.

Genus 2. HOMALOGYRA, Jeffreys.

Homalogyra rota, Forbes & Hanley. *Op. cit.* iv. p. 71, v. pl. 70. f. 3.
In shell-débris from the West Sands. Dead.

Fam. 13. **Turritellidæ**, Clark.

Genus TURRITELLA, Lamarck.

Turritella terebra, L. *Op. cit.* iv. p. 80, v. pl. 70. f. 6.
Common in deep water. Var. *nivea* is also not rare. A favourite food of the codfish, probably in many cases on account of its tenant the hermit crab.

Fam. 15. **Scalariidæ**, Broderip.

Genus SCALARIA, Lamk.

Scalaria Trevelyana, Leach. *Op. cit.* iv. p. 93, v. pl. 71. f. 4.
From the fishing-boats, and on the West Sands after storms. Rather rare.

Fam. 16. **Pyramidellidæ**, Gray.

Genus 2. ODOSTOMIA, Fleming.

Odostomia rissoïdes, Hanley. *Op. cit.* iv. p. 122, v. pl. 73. f. 4.
Common in shell-sand.

Odostomia clathrata, Jeffreys. *Op. cit.* iv. p. 148, v. pl. 74. f. 9.
Worn specimens not uncommon in shell-débris from the West Sands.

Odostomia indistincta, Montagu. *Op. cit.* iv. p. 149, v. pl. 75. f. 1.
Occasionally in shell-sand from the West Sands.

Odostomia interstincta, Montagu. *Op. cit.* iv. p. 151, v. pl. 75. f. 2.
In shell-sand from the same locality.

Odostomia nitidissima, Montagu. *Op. cit.* iv. p. 173, v. pl. 76. f. 8.
In débris from the West Sands.

Fam. 19. **Eulimidæ**, H. & A. Adams.

Genus Eulima, Risso.

Eulima bilineata, Alder. *Op. cit.* iv. p. 210, v. pl. 77. f. 8.
In muddy débris on old shells from deep water.

Fam. 20. **Naticidæ**, Swainson.

Genus Natica, Adanson.

Natica islandica, Gmelin. *Op. cit.* iv. p. 214, v. pl. 78. f. 1.
A single specimen from the fishing-boats.

Natica catena, Da Costa. *Op. cit.* iv. p. 220, v. pl. 78. f. 4.
Common on the sandy bottom off the West Sands. The ova occur abundantly in July and August.

Natica Alderi, Forbes. *Op. cit.* iv. p. 224, v. pl. 78. f. 5.
Less abundant than the foregoing, on the same ground.

Fam. 22. **Velutinidæ**, Gray.

Genus 1. Lamellaria, Mont.

Lamellaria perspicua, L. *Op. cit.* iv. p. 235, pl. 3. f. 6, v. pl. 79. f. 2 & 2 *a*.
Common under stones between tide-marks, especially in

rock-pools. The figure of the living specimen in Mr. Gwyn Jeffreys's work (iv. pl. 3. f. 6) was copied from a coloured drawing of my sister's. The colours of this species vary in a remarkable manner.

Genus 2. VELUTINA, Fleming.

Velutina lævigata, Pennant. *Op. cit.* iv. p. 240, v. pl. 79. f. 4.

Frequent in the laminarian region, and on the West Sands after storms; occasionally under stones at the verge of low water.

Fam. 23. **Cancellariidæ**, Forbes & Hanley.

Genus 2. TRICHOTROPIS, Broderip & Sowerby.

Trichotropis borealis, Brod. & Sowerb. *Op. cit.* iv. p. 245, v. pl. 79. f. 6.

A single specimen from the stomach of a cod.

Fam. 24. **Aporrhaidæ**, Troschel.

Genus APORRHAIS, Da Costa.

Aporrhaïs pes-pelecani, L. *Op. cit.* iv. p. 250, v. pl. 80. f. 1.

Abundant on the West Sands after storms, and frequent in the débris of the fishing-boats.

Fam. 27. **Buccinidæ**, Fleming.

Genus 1. PURPURA, Bruguière.

Purpura lapillus, L. *Op. cit.* iv. p. 276, v. pl. 82. f. 1.

Very abundant between tide-marks on rocks and stones. Varieties are common.

Genus 2. BUCCINUM, L.

Buccinum undatum, L. *Op. cit.* iv. p. 285, v. pl. 82. f. 2–5.

Common in the living state (var. *littoralis*) in pools at the East Rocks, especially where a stream of salt water rushes through the seaweeds. This species spawns in October, November, and the following months; the young are found in swarms on the egg-cases in May. Frequent on the West Sands after storms.

Genus 5. TROPHON, De Montfort.

Trophon truncatus, Ström. *Op. cit.* iv. p. 319, v. pl. 84. f. 6.

Not uncommon in the fishing-boats, and from the stomachs of the cod, haddock, and flounder.

Genus 6. Fusus, Bruguière.

Fusus antiquus, L. *Op. cit.* iv. p. 323, v. pl. 85. f. 1 & 2.

Abundant in the coralline zone, and frequently thrown on shore after storms.

Fusus gracilis, Da Costa. *Op. cit.* iv. p. 335, v. pl. 86. f. 2.

Common on the West Sands after storms, and often brought in by the fishing-boats.

Fusus propinquus, Alder. *Op. cit.* iv. p. 338, v. p. 219, pl. 86. f. 3.

Occasionally procured from the deep-sea lines of the fishermen.

Fam. 29. **Nassidæ**, Stimpson.

Genus 1. Nassa, Lamk.

Nassa incrassata, Ström. *Op. cit.* iv. p. 351, v. pl. 88. f. 1.

Common in the laminarian region and under stones between tide-marks; while worn shells are abundant in débris at the East Rocks.

Fam. 30. **Pleurotomidæ**, Lovén.

Genus 1. Defrancia, Millet.

Defrancia linearis, Mont. *Op. cit.* iv. p. 368, v. pl. 89. f. 2.

From deep water; rather rare.

Genus 2. Pleurotoma, Lamk.

Pleurotoma costata, Donovan. *Op. cit.* iv. p. 379, v. pl. 90. f. 3.

Occasionally in shell-débris from the West Sands.

Pleurotoma rufa, Montagu. *Op. cit.* iv. p. 392, v. pl. 91. f. 6.

Common on the West Sands after storms.

Pleurotoma turricula, Montagu. *Op. cit.* iv. p. 395, v. pl. 91. f. 7.

Abundant under the same circumstances.

Pleurotoma Trevelyana, Turton. *Op. cit.* iv. p. 398, v. pl. 91. f. 8.

Not uncommon in the stomachs of cod and haddock.

Fam. 31. **Cypræidæ**, Fleming.

Genus 2. Cypræa, L.

Cypræa europæa, Mont. *Op. cit.* iv. p. 403, pl. 7. f. 4, v. pl. 92. f. 2.

Not uncommon at extreme low water, under stones in pools in the same region at the East Rocks, and generally in the laminarian region. The living animal represented in Mr. Gwyn Jeffreys's work is from a coloured drawing by my sister.

Order IV. Pleurobranchiata, Gray.

Fam. 1. **Bullidæ**, Clark.

Genus 1. Cylichna, Lovén.

Cylichna cylindracea, Pennant. *Op. cit.* iv. p. 415, v. pl. 93. f. 4.

Abundant in deep water; generally thrown on the West Sands after storms.

Genus 2. Utriculus, Brown.

Utriculus truncatulus, Bruguière. *Op. cit.* iv. p. 421, v. pl. 94. f. 2.

Occasionally from deep water, and in débris on sands.

Utriculus obtusus, Mont. *Op. cit.* iv. p. 423, v. pl. 94. f. 3.

Not uncommon in deep water. A variety with a more extended spire is often met with in shell-débris from the West Sands.

Genus 4. Actæon, De Montfort.

Actæon tornatilis, L. *Op. cit.* iv. p. 433, v. pl. 95. f. 2.

Frequent off the West Sands, and thrown ashore after storms.

Genus 6. Scaphander, De Montfort.

Scaphander lignarius, L. *Op. cit.* iv. p. 443, v. pl. 95. f. 5.

Not uncommon in deep water, and thrown ashore alive after storms.

Genus 7. PHILINE, Ascanius.

Philine scabra, Müller. *Op. cit.* iv. p. 447, v. pl. 96. f. 1.

Abundant in deep water, and in the stomachs of cod, haddock, and flounders. The shells occur on the West Sands after storms.

Philine pruinosa, Clark. *Op. cit.* iv. p. 454, v. pl. 96. f. 6.

From the stomach of a haddock; rare.

Philine aperta, L. *Op. cit.* iv. p. 457, v. pl. 96. f. 8.

Occasionally from deep water; shells thrown on the West Sands after storms.

Fam. 2. **Aplysiidæ**, D'Orbigny.

Genus APLYSIA, L.

Aplysia punctata, Cuvier. *Op. cit.* v. p. 5, pl. 97. f. 1.

A single specimen was found in autumn amongst the seaweeds of a large pool at extreme low water. No spots or other markings were present on the dull olive hue of the body.

Order V. NUDIBRANCHIATA, Cuvier.

Suborder 1. **PELLIBRANCHIATA.**

Fam. 1. **Limapontiidæ**, Alder & Hancock.

Genus 1. LIMAPONTIA, Johnston.

Limapontia nigra, Johnston. *Op. cit.* v. p. 28, pl. 1. f. 5.

Not uncommon amongst the seaweeds under stones in rock-pools.

Suborder II. **POLYBRANCHIATA.**

Fam. 3. **Eolididæ**, D'Orbigny.

Genus 2. EOLIS, Cuvier.

Eolis papillosa, L.; Alder & Hancock, Brit. Nud. Moll. fam. 3, pl. 9.

Abundant in early spring (February) amongst the rocks near low water, and occasionally at other times.

Eolis coronata, Forbes; A. & H. B. Nud. M. fam. 3, pl. 12.

Common in February and the spring months in the same localities.

Eolis rufibranchialis, Johnston; A. & H. B. Nud. M. fam. 3, pl. 16.

With the foregoing; common.

Eolis olivacea, Alder & Hancock; A. & H. B. Nud. M. fam. 3, pl. 26.

Not uncommon under stones in pools at all seasons.

Eolis viridis, Forbes; A. & H. B. Nud. M. fam. 3, pl. 32.

Abounds on the small hydroid zoophytes under stones in rock-pools.

Eolis Farrani, Alder & Hancock; A. & H. B. Nud. M. fam. 3, pl. 35.

Occasionally occurs under stones at low-water mark at the East Rocks. The fine purple variety has been found more than once. A specimen shows the abnormality of a clavate median process between the oral and dorsal tentacles.

Eolis Adelaidæ, Thompson; Jeffreys, Brit. Moll. v. p. 55.

A single specimen was found in a sandy pool in August.

Eolis exigua, Alder & Hancock; A. & H. B. Nud. M. fam. 3, pl. 37.

Not uncommon on laminarian blades thrown on the West Sands after storms.

Fam. 5. **Dotonidæ.**

Genus Doto, Oken.

Doto fragilis, Forbes; A. & H. B. Nud. M. fam. 3, pl. 5.

Occasionally on zoophytes brought in by the fishing-boats.

Doto coronata, Gmelin; A. & H. B. Nud. M. fam. 3, pl. 6.

Common in the débris of the fishing-boats; small specimens are frequently found in groups on *Sertularia pumila* under stones in rock-pools near low-water mark; also on laminarian blades after storms. One example has an abnormal left tentacle.

Fam. 6. **Dendronotidæ.**

Genus 1. Dendronotus, Alder & Hancock.

Dendronotus arborescens, Müller; A. & H. B. Nud. M. fam. 3, pl. 3.

Not uncommon amongst zoophytes from deep water, on laminarian blades thrown on the West Sands, and occasionally at extreme low water. A white variety is sometimes seen.

Fam. 8. **Tritoniidæ**, H. & A. Adams.

Genus Tritonia, Cuvier.

Tritonia Hombergi, Cuv.; A. & H. B. Nud. M. fam. 2, pl. 2.

From deep water. Both pale and deep reddish-brown varieties are found on the zoophytes in the fishing-boats. Occasionally in the stomach of the cod.

Tritonia plebeia, Johnston; A. & H. B. Nud. M. fam. 2, pl. 3.

In vast numbers amongst the zoophytes from deep water, in the crevices of *Alcyonium digitatum* and on *Halecium* tossed ashore after storms. One specimen showed the abnormality of a bifid tail.

Suborder III. **ACANTHOBRANCHIATA.**

Fam. 1. **Polyceridæ.**

Genus 1. Ægirus, Lovén.

Ægirus punctilucens, D'Orbigny; A. & H. B. Nud. M. fam. 1, pl. 21.

Not uncommon under stones in rock-pools between tide-marks at the East Rocks.

Genus 2. Triopa, Johnston.

Triopa claviger, Müller; A. & H. B. Nud. M. fam. 1, pl. 20.

Fine specimens are occasionally found under stones near low-water mark. The same *Ergasilus* is parasitic on this as on *Doris*.

Genus 5. Polycera, Cuvier.

Polycera quadrilineata, Müller; A. & H. B. Nud. M. fam. 1, pl. 22.

Not uncommon near low-water mark and in the laminarian region.

Polycera ocellata, Alder & Hancock; A. & H. B. Nud. M. fam. 1, pl. 23.

Gregarious under stones between tide-marks, but not common. They chiefly occur at the West Rocks.

Polycera Lessoni, D'Orbigny; A. & H. B. Nud. M. fam. 1, pl. 24.

On a laminarian blade after an October storm; one specimen.

Genus 6. ANCULA, Lovén.

Ancula cristata, Alder; A. & H. B. Nud. M. fam. 1, pl. 25.

Not rare under stones in rock-pools, chiefly at the East Rocks.

Genus 8. GONIODORIS, Forbes.

Goniodoris nodosa, Mont.; A. & H. B. Nud. M. fam. 1, pl. 18.

Abundant between tide-marks under stones in rock-pools and elsewhere, throughout the year.

Fam. 2. **Dorididæ.**

Genus DORIS, L.

Doris tuberculata, Cuvier; A. & H. B. Nud. M. fam. 1, pl. 3.

Abundant under rocky ledges and under stones in pools. Its parasite, *Ergasilus*, is common.

Doris Johnstoni, Alder & Hancock; A. & H. B. Nud. M. fam. 1, pl. 5.

Occasionally under stones in pools between tide-marks at the East Rocks. The same *Ergasilus* occurs on this species.

Doris repanda, Alder & Hancock; A. & H. B. Nud. M. fam. 1, pl. 6.

Abundant at all seasons amongst the rocks between tide-marks.

Doris aspera, Alder & Hancock; A. & H. B. Nud. M. fam. 1, pl. 9. f. 1–9.

Common under stones in pools near low-water mark.

Doris bilamellata, L.; A. & H. B. Nud. M. fam. 1, pl. 11.
Abundant between tide-marks at all seasons; in swarms in March.

Doris pilosa, Müller; A. & H. B. Nud. M. fam. 1, pl. 15.
Common at all seasons between tide-marks.

Class CEPHALOPODA.

Order DIBRANCHIATA, Owen.

Fam. 1. **Teuthidæ**, Owen.

Genus 1. OMMATOSTREPHES, D'Orbigny.

Ommatostrephes todarus, Delle Chiaje, Mem. An. s. Vert. Nap. iv. Mem. ii. tav. 60.
Frequently thrown in numbers on the West Sands, especially after April storms.

Genus 2. LOLIGO, Schneider.

Loligo vulgaris, Lamarck. Jeffreys, Brit. Moll. v. p. 130, pl. 5. f. 2.
The shells are sometimes found in the stomachs of codfish. The spawn of this species is frequent.

Genus 4. SEPIOLA, Rondelet.

Sepiola Rondeletii, Leach. *Op. cit.* v. p. 136, pl. 6. f. 2.
The sole specimen occurred in the stomach of a flounder.

Fam. 3. **Octopidæ**, D'Orbigny.

Genus 2. ELEDONE, Leach.

Eledone cirrosa, Lamk. *Op. cit.* v. p. 146, pl. 7. f. 2.
Occasionally in pools between tide-marks, and on the West Sands after storms; common in the stomachs of cod and haddock.

[To be continued.]

LX.—*On* Halisarca lobularis, *Schmidt, off the South Coast of Devon, with Observations on the Relationship of the* SPONGES *to the* ASCIDIANS, *and Hints for Microscopy.* By H. J. CARTER, F.R.S. &c.

REFERRING to my account of *Halisarca Dujardinii* given in the number of the 'Annals' for April, 1874, p. 315, I (taking advantage of the low tide on the 17th April) again visited the "rocks" here, for the purpose, if possible, of finding out the habitat of this sponge, and, when the tide was at its lowest ebb, observed it plentifully on short bits of *Chondrus crispus* and other small flat-fronded seaweeds of the same kind. But it may grow here and there on almost any and every thing, even to the bare rock itself, although, to the best of my knowledge, never anywhere where it is likely to be uncovered long by the sea-water.

In his 'Adriatic Sponges' of 1862, p. 80, Schmidt states, with reference to what Johnston said in England of this sponge, and Lieberkühn in Heligoland, that it was "white" (*weiss*). But if we are to take as "white" sponges *Grantia nivea* and the like, which look like so much snow, then the term "white" is not applicable to *Halisarca Dujardinii.*

Dujardin, who found it on the coast of Normandy and first described it, uses the term "blanchâtre;" Johnston, who found it on the coast of Northumberland, called it "straw- or ochre-yellow-coloured, mottled;" and Lieberkühn, who studied it in Heligoland, uses the words "weisslich grau;" while my own observations in this respect accord with those of Johnston, to which it might be added that when transferred to spirit and water, it becomes opaque and more yellow from the coagulating power of the alcohol over the translucent albumen of which the sponge is chiefly composed.

While engaged in looking after the habitat of *Halisarca Dujardinii*, I observed a pinkish lobulated substance growing on the rock amongst as well as over other sponges, and, having knocked off the bit of rock on which it was growing, without much injuring the sponge itself, put the whole into sea-water immediately, and thus took it home; where on closer examination I found it to be a specimen of Schmidt's *Halisarca lobularis*, of the Adriatic Sea, hitherto, I think, not enumerated among the sponges of the British coasts.

The diagnosis of this sponge given in Latin by Schmidt (*l. c.*) is short and conclusive, viz.:—"*Halisarca* obscure violacea irregulariter plicata et lobata."

On the following day I fed this specimen of *Halisarca lobularis* with indigo; and although it only took in this par-

tially, so as to become deeply coloured here and there, it was quite sufficient for me to be able to distinguish the spongozoa from the other parts of the structure &c., as will be seen hereafter. Meanwhile, as Schmidt's description is rather meagre, and the sponge would appear not to have been noticed on our coasts before, it may not be unacceptable to some to have the following description of the specimen that I have just found on the south coast of Devon.

Halisarca lobularis, Schmidt.

General form.—Sponge lobate, consisting of irregularly lobed ridges about a line high, extending themselves in branched digitations over the rock and adjoining sponges. Lobes ficoid, agglomerated, divided into minute lobuli with angular pits or intervals between them where they cannot, from their rounded form, come into contact. Surface smooth, sleek, and of a pink colour on the prominent portions, passing into light brown-yellow below. Vents sparse, situated here and there on the lobes, not raised above the surface, and sufficiently large to be visible to the naked eye. Pores minute and numerous, each consisting of a round aperture situated in the centre of a papilliform ring—which rings being in juxtaposition, thus form the dermal surface of the lobule.

Internal structure composed of spongozoa, aggregated into sac-like forms of various shapes and sizes, some of which are distinctly conical elongate, and have their narrow ends respectively in connexion with a canal leading inwards from the pore, imbedded in a kind of trama consisting of sarcode (filamentous ?) and granuliferous cells, but with their confines neatly defined by a translucent linear interval; also of pore-canals forming a network extending inwards from the surface, and of a branched system of excretory canals terminating in the vents. No spicules of any kind, but here and there small globular masses of minute uniform granules possessing a nucleus (nuclear utricle), and small spherical opaque nucleus (nucleolus), with germinal spot or vesicle, no doubt ova. Pink colour confined to the spongozoa in the prominent parts of the lobes, whereby their sac-like aggregations here become more distinctly differentiated.

Size of specimen about 1¼ inch long by 1 inch wide and 1 line high. Pores of the specimen in spirit 1-1660th inch in diameter; papilliform circles surrounding them from 1½–2-830ths inch in diameter. Vents variable in size, but large enough to be seen by the unassisted eye.

Hab. New Red Sandstone rocks, lower surface; between tides.

Loc. South coast of Devon, Budleigh-Salterton.

Obs. This specimen of *Halisarca lobularis*, of which the type was originally found by Schmidt in the Adriatic Sea at Subanico, does not differ from his description in any essential point. The pink colour on the prominent parts (stated by Schmidt to be "dark violet" in the Adriatic) goes very soon after immersion in spirit and water, where its original translucence is replaced by whitish yellow opacity.

The deep triangular puncta or interspaces between the lobules appear to be caused in the way above mentioned, and therefore lead to nothing; while the surface of the lobules is formed of the papilliform openings of the pores, which are far too small to be seen with the naked eye, or even any thing below an inch compound power.

The most remarkable points about the pink colour are:—first, that it is exclusively confined to the spongozoa, whereby it would appear that the colour of sponges generally is seated in the spongozoa, as in *Halisarca lobularis*; and, second, that by this pink colour in the living state the form of the sac-like aggregations of the spongozoa can be as distinctly seen as if the latter had been fed with indigo. Lower down, however, the absence of the pink colour renders this differentiation less evident; while the presence of the indigo here, after the sponge has been fed with it, causes the differentiation to be more striking even than in the pink portions, where the latter colour somewhat obscures it.

Halisarca lobularis differs from *H. Dujardinii* in the following particulars, viz.:—*H. lobularis*, in the fresh state, is lobed and lobulated, tinted pink on the prominent parts, sleek on the surface, and provided with sparse vents on a *level* with the surface. *H. Dujardinii*, on the other hand, in the living state, is uniformly flat and even, of a yellowish grey colour, sleek on the surface, and sparsely provided with vents, which are projected *above the level* of the sponge by a short tubular prolongation of the dermal sarcode. Both may be charged with ova after the manner of sponges generally, as some specimens of the latter from the Isle of Man (lately sent to me by my friend Mr. Higgin, of Liverpool) testify.

Having already found two specimens of *H. lobularis*, and knowing now what to look for, viz. a pink colour, lobulated form, and sleek shining surface, I dare to say that I shall often meet with it.

Of course Schmidt's diagnosis of *Halisarca*, viz. that it possesses neither siliceous nor calcareous spicules, obtains with *Halisarca lobularis*.

Ampullaceous Sacs and Spongozoa.
(Häckel's "Gastrula" when developed *in situ*?)

In the 'Annals' of 1857, vol. xx. p. 21, I published a description of the "Ultimate Structure of *Spongilla*," which appears to me, so far, to be typical of every other sponge, both marine and freshwater, that I have examined.

It was there that I first described and figured the "ampullaceous sac," after having fed the *Spongilla* with carmine, and showed that this sac was composed of a pavement-layer of monociliated cells (spongozoa) with a distinct and common aperture; also that each spongozoon took in fragments of carmine, while its cilium might be seen to vibrate in the cavity of the ampullaceous sac (*l. c.* pl. 1. fig. 5, &c.). The terms "sac" and "cell" involve the idea of a sac- and cell-wall respectively, which here must be maintained on inference rather than demonstration. There must be a "vanishing-point" in early development; and to assume that a tissue cannot exist in such a subtile state as not to be appreciable by our senses, seems to me to be an untenable position. In this sense, therefore, I use the terms "sac" and "cell" for these sarcodal bodies respectively.

At p. 28 (*l. c.*) it is stated (with reference to the undigested portions) that, "after a certain time, the particles of carmine which have accumulated round the inner surface of the sac are gradually thrown off from its circumference, and falling into the efferent system of canals, are thus carried away and finally ejected." It will be for us to consider, by-and-by, whether this takes place through the pavement-layer of the spongozoa *generally*, or at *one* particular point of the sac.

Lastly, in the 'Annals' of 1873, vol. xii., in my paper on the Gumminese, it is stated at p. 27:—"I cannot help thinking that there are more species than *Halisarca Dujardinii* to be found on our coasts; so I hope to meet with not only this, but other species of the family here in a living state, through which I may, by experiment, be able to add something more satisfactory to our knowledge of their intimate structure than we at present possess."

My anticipation in this respect will have been seen to have been realized in the discovery of *Halisarca Dujardinii* and *H. lobularis* on this coast; while it so happens that by having fed the latter with indigo, still more precise information of the nature of the ampullaceous sac has been obtained.

By the above description of *H. lobularis* it will also have been seen that the ampullaceous sac is not only rendered more distinct by the presence of the indigo in the spongozoa,

but that it is rendered almost equally so in the most prominent parts by the pink colour of the spongozoa in the living condition of the sponge. Hence we have thus a distinct organ presented to us for consideration, viz. the ampullaceous sac.

And first, as regards its form in *H. lobularis*, this is irregularly round, but, in many instances, distinctly conical elongate; for all these sacs are neatly defined, as before stated, by a translucent linear interval, which may thus be compared to the crystalline calcspar that surrounds the brecciated fragments of a marble rock. To this translucent linear interval we shall return presently.

Meanwhile, taking the "conical elongate" sac, we thus have a fundus and a neck. The former, from its rounded contour, is clearly defined by the translucent linear interval; while the latter, from the presence of the indigo, shows (where the sac is close to the surface) that it is in direct continuation with the pore by a short tubular prolongation.

Further, it might be observed that the pore-canals branch off internally so as to form a reticulation, which, following the translucent linear intervals just mentioned, thus reaches the *oral* apertures, as they may be termed, of the more deep-seated ampullaceous sacs respectively.

From the pore on the surface to the ampullaceous sac we can thus trace the indigo and thence into the bodies of the spongozoa. And that the spongozoa are the only bodies which take in the indigo, may be inferred from its *absence* in all other bodies or cells of a like kind in the structure of the sponge.

Here the indigo remains, and hence the easiness with which we can make the demonstration. Not so, however, when the undigested portions are transferred to the excretory canal; for here they are *instantly* discharged. Hence the difficulty of following their course from the interior of the ampullaceous sac to the excretory canal. In *Spongilla*, as before stated, I have seen this take place, but have never yet been able to pronounce whether the undigested particles of colouring-matter are transferred through the pavement-layer of spongozoa *generally* or at *one* specialized point of the ampullaceous sac.

If the former, it necessitates our assuming that the whole of the ampullaceous sac up to its neck is enclosed in a dilated extremity of a branch of the excretory canal-system; if the latter, that there is a specialized point in the ampullaceous sac, tantamount to an *anal* orifice, continuous with the branch of the excretory canal.

I incline to the latter, as being the most probable conjecture;

and if right, then we see the resemblance of the ampullaceous sac to the Ascidian, more especially of the compound Tunicata, in so far that each has an *oral* and an *anal* aperture.

"Very good," it may be stated; "but what have you in the Ascidian to compare to your individualized spongozoa, each of which appears to be a distinct animal?"

In reply to this I would observe that if among the compound Tunicata (which, being of the same habitat as *Halisarca*, grow plentifully together) we select a species that, by its translucence, permits of the young or embryonal Ascidians of the group being viewed under a microscope throughout their development, we may see that, at one stage, the young Ascidian is almost identical in appearance with the ampullaceous sac—that is, that it is composed of a pavement of cells aggregated into a sac-like form. Finally the internal organs of the Ascidian are developed, and the sac acquires an oral and an anal aperture. But in the sponge—that is, in *Halisarca* (as we are now more particularly engaged with this sponge)—the cells of the pavement-layer pass into individualized animals, each of which takes in its proper nutriment, and probably possesses individually or conjointly its proper generative function; for to assume that they do not possess the latter would be to assume that the isolated forms described and figured by the late Prof. James-Clark ('Annals,' 1868, vol. i. p. 133, pl. v.) do not possess this power.

Thus the development of the ampullaceous sac is arrested, and the cells adapt themselves to that condition which ends in the evolution of a sponge; while the sac and its cells in the development of the Ascidian go on to the evolution of a compound tunicated group.

To make this more intelligible it might be stated that if, by the theory of evolution, the monad passes up to man, the monadine cell could not, at the time of reproduction, have been identical with the human ovum, because it must have possessed specialized powers of self-nutrition and immediate generation.

At the same time the differentiation that takes place in the evolution of the variously formed cells composing respectively the organs of the human body, from the simple cell-form of the human ovum, points out differences almost as great if not as numerous as those in the animals between man and the monad.

Hence we see that an organic cell may be at one time one thing and at another another, arising simply from adaptation to the functions required. Thus the cell or spongozoon of the ampullaceous sac becomes an individualized animal,

and the *whole* sac, with its oral and anal apertures, so far like an Ascidian; while the sac with its pavement-lining of cells in the compound tunicated animal goes on unarrested to produce an Ascidian. It is on this account that I have stated that there is a greater relation between the Sponges and the Ascidians than between the Sponges and the Corals, whose polypes have but one aperture for both purposes.

To produce the "adaptation" there must be, of course, a creative or directing power, which, being *infinite*, we can never comprehend.

I would here add, for the information of those who care to experimentalize on the living sponges by feeding them with indigo or carmine (magenta will not do, for it dyes *all* alike), that the portion of sponge must be taken from its habitat without injury, put in sea-water directly, kept there until the following day (forenoon); the water then changed, and the indigo or carmine added by having been rubbed off a cake of one or other of these substances in sea-water, and dropped upon the sponges, where it should be allowed to remain about an hour, always remembering that the experiment will be unsuccessful if it be not previously ascertained, by the ejection of particles from the vents (which can be seen under a 1-inch compound power), that the sponge is living and *active*. Portions may then be examined microscopically, after which the sponge should be placed in spirit and water for doing this at convenience.

A priori it might be considered desirable to have the sponge as fresh as possible; but experiment has taught me otherwise, viz. that to get the cilia retained with the indigo still in the body of the spongozoon, the sponge should be kept for a day first, in the way above stated, whereby, being weakened and hungry perhaps, the experiment is more likely to succeed.

Then, of course, the best plan is to examine a portion while the sponge is yet *alive*; after which it may be placed, as above noticed, in spirit and water for more deliberate observation. In this state, too, a portion may be torn to pieces on the slide, dried and mounted in balsam, when, in many instances, the general form of the body and cilium will still be retained; or the fragments may be dyed with magenta, when the cilium will become still more evident; but, of course, what will render the transparent sarcode visible, will be likely to obscure the particles of indigo. Lastly a fragment having been torn to pieces on the slide in water, it may be *simply* dried, when the cilium will become more evident than in the wet state.

In examining minute objects, it is very desirable to acquire the power of holding a lens with the eye after the manner of a watchmaker; this, besides giving as it were a third hand, enables the operator, by means of a very high power, to pick out objects from material spread over the slide, through the aid of a subjacent mirror or black ground, and thus turn them over and over so as to obtain a view, under a compound power, of all parts of the object, such as it might be difficult, if not impossible, to get under any other circumstances.

Again, the microscopist should also endeavour, when he has got the focus of the "fine adjustment," to render it still finer by gently pressing down the tube, whose resiliency, up and down, will thus give the observer a better idea of a minute object than any other means. Indeed it is absolutely necessary with *very* minute objects.

LXI.—*A Revision of the Genera* Epicharis, Centris, Eulema, *and* Euglossa, *belonging to the Family* Apidæ, *Section* Scopulipedes. By Frederick Smith, Assistant in the Zoological Department of the British Museum.

[Concluded from p. 373.]

Section Corbiculipedes.

Genus Eulema, St.-Farg.

Generic Characters.

Head narrower than the thorax; the clypeus produced anteriorly; the labrum subquadrate, convex, its anterior margin slightly curved; mandibles subdentate, having on their inner margin three blunt teeth; the tongue elongate, nearly as long as the body: the maxillary palpi two-jointed, the first joint shorter than the second, its apex truncate; the second joint twice the length of the basal one, pear-shaped, and with a long stiff bristle near its apex: the labial palpi elongate, setiform, two-jointed, the division of the joints obscure. *Thorax*: wings with one elongate marginal cell and three submarginal cells, the first and second of nearly equal length, the third as long as the first and second united; the first recurrent nervure received by the second submarginal cell near its apex, the second recurrent uniting with the third transverse nervure. The posterior tibiæ of the females much flattened, concave exteriorly: in the male the tibiæ are convex, and concave above, two thirds of their length from their apex towards their base.

The above characters are those of the type of the genus, *Eulema dimidiata*. This genus can only be separated from that of *Euglossa* by an examination of the oral organs. I have failed to observe more than two joints in the labial palpi; and upon this circumstance alone have I kept it separated from *Euglossa*. The characters given by St.-Fargeau are not reliable; and the difference which he alludes to in the neuration of the wings has no existence; in both genera the neuration is the same. The labrum varies slightly in the species, being sometimes square, sometimes slightly narrowed anteriorly; the males in both genera have the posterior tibiæ thickened, being convex outwardly. The scutellum is sometimes flat, sometimes a little convex; it has frequently a fossulet at its posterior margin, or a depression, the sides of which are elevated so as to become bituberculate.

The insects belonging to this genus, Mr. Bates informs us, are solitary in their habits. In the second volume of the 'Naturalist on the River Amazons' he observes of *Eulema surinamensis*:—"This species builds its solitary nest in crevices of walls or trees; but it closes up the chink with fragments of dried leaves and sticks cemented together, instead of clay. It visits the cajú-trees, and gathers with its hind legs a small quantity of the gum which exudes from their trunks; to this it adds the other materials required from the neighbouring bushes, and when laden flies off to its nest." The dilated posterior tibiæ, fringed at the sides, and thus forming a basket (similar to that on the legs of the hive-bee), has led to the supposition of the insects of this genus being social; but direct observation proves the contrary. These bees are furnished with two spines at the apex of the posterior tibiæ, which none of the permanently social genera possess. The genus *Bombus*, which is temporarily social, has spines similar to the genera *Eulema* and *Euglossa*, and has also the posterior tibiæ expanded and fringed at the sides in the same manner as those genera. Thus we have a gradation in structure, as well as in habit, from *Eulema* to *Euglossa*, and thence on to *Bombus* and the genera *Melipona*, *Trigona*, up to the genus *Apis*.

1. *Eulema dimidiata*.

Eulema dimidiata, St.-Farg. Hym. ii. p. 12, ♂ ♀.
Apis dimidiata, Fab. Ent. Syst. ii. p. 316.
Centris dimidiata, Fab. Syst. Piez. p. 354; Schomb. Faun. Flor. Brit. Guiana, p. 519.
Euglossa dimidiata, Perty, Del. An. Art. p. 151, tab. xxviii. f. 14, ♀.

Hab. Cayenne; Para; Rio de Janeiro; Bahia; St. Paulo; Chontales; British Guiana.

This species varies not only in colouring but also in size. The three apical segments are usually covered with ferruginous pubescence; but specimens from Rio and others from Chontales have the segments clothed with pale yellowish white. In size it varies from 14 to 9 lines in both sexes.

This insect is figured in Madame Merian's 'Insects of Surinam,' plate 48.

2. *Eulema cajennensis.*

Eulema cajennensis, St.-Farg. Hym. ii. p. 14, ♂.
E. fasciata, St.-Farg. *ibid.* p. 12, ♀ ♂.

Hab. Cayenne; Para; Honduras; Mexico.

I have seen the type of the species named "*fasciata*" by St.-Fargeau; the male is a rather worn specimen: that described as "*cajennensis*" is certainly the same species in good condition.

3. *Eulema elegans.*

Eulema elegans, St.-Farg. Hym. ii. p. 13, ♀.

Hab. Cayenne; Santarem; Chontales.

I have examined St.-Fargeau's type specimen of this species, and have seen examples from the above localities. The male has the face of a metallic green, with more or less of a coppery tinge; the thorax, anteriorly, has also a metallic lustre, as well as the tegulæ; the posterior tibiæ are convex. The species is closely allied to *E. cajennensis.*

4. *Eulema terminata.*

Male. Length 13 lines. Head and thorax black, the abdomen obscurely æneous; the pubescence black, excepting that on the fifth and sixth segments of the abdomen, which is pale fulvous; the apical segment pale testaceous; the wings dark fuscous from the tegulæ to the base of the marginal cell, beyond which they are pale flavo-hyaline; the posterior tibiæ with the longitudinal excavation above terminating in an acute spine on each side at its apex. The spines are more acute than in the male of *E. dimidiata.*

Hab. Trinidad.

5. *Eulema surinamensis.*

Eulema surinamensis, St.-Farg. Hym. ii. p. 13.
Apis surinamensis, Linn. Syst. Nat. i. p. 961; Drury, Exot. Ins. iii. tab. xliii. fig. 4; De Geer, iii. p. 43, fig. 4; Fab. Ent. Syst. ii. p. 318.
Centris surinamensis, Fab. Syst. Pies. p. 355; Schomb. Faun. Flor. Brit. Guiana, p. 592.
Euglossa surinamensis, Westw. Nat. Libr. xxxviii. p. 261, pl. xix. fig. 1; Humb. et Bonp. p. 592, pl. xvii. fig. 12.

Hab. Surinam; Para; Rio de Janeiro; Columbia; British Guiana; Mexico.

6. *Eulema fallax.*

Eulema fallax, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 381, ♂.

Hab. Para.

This species is very closely allied to "*surinamensis*," of which it may possibly be a variety. It has, however, no yellow markings on the face, as in the male of that species, which has a narrow longitudinal line down the middle of the clypeus, two spots at its anterior margin, and usually a minute spot on each side about the middle of its margin; there is also a spot on the face opposite the insertion of the antennæ: the male of *E. fallax* has the face, the thorax anteriorly, and the tegulæ bright green, and the abdomen is entirely clothed with fulvo-ochraceous pubescence; in "*surinamensis*" the basal segment is covered with black pubescence.

Genus Euglossa, Latr.

Generic Characters.

The maxillary palpi two-jointed, the basal joint hidden in a cavity; the second spindle-shaped, with a long bristle at its apex. The labial palpi four-jointed; the two basal joints elongate, the third and fourth minute, attached to the second joint near its apex. The labrum quadrate, with the anterior angles rounded. The mandibles tridentate. Wings and legs as in the genus *Eulema*. The body in some species entirely naked.

1. *Euglossa cordata.*

Euglossa cordata, Latr. Hist. Nat. Crust. et Ins. iii. p. 384; Fabr. Syst. Piez. p. 363; St.-Farg. Hym. ii. p. 9, ♂ ♀; Schomb. Faun. Flor. Brit. Guiana, p. 592.
Apis cordata, Linn. Syst. Nat. i. p. 955.
Chemidium viride, Perty, Del. An. Art. p. 149, tab. xxviii. fig. 9.
Euglossa analis, Westw. Nat. Libr. xxxviii. p. 262, pl. xix. fig. 2 (1840).

Hab. Cayenne; Santarem; Para; Ega; Catagallo; Jamaica; Mexico.

Having examined a very large number of examples, I have come to the conclusion that it is a species that runs into great variety of coloration, the majority being of a vivid green; others have a golden lustre; then others are blue, or blue with shades of purple; some have the head and thorax blue, with the abdomen purple; the most beautiful variety is that with the head and thorax purple, and the abdomen brilliant carmine: these and other mixtures of coloration occur. *E. analis* of Westwood is a beautiful variety: the head and

thorax blue, clypeus at the sides, the labrum, and mandibles white; thorax green beneath; abdomen purple, terminal segments golden green.

2. *Euglossa piliventris.*

Euglossa piliventris, Guér. Icon. Règne Anim. p. 458, ♂ ♀.

Hab. Para; West Indies.

3. *Euglossa ignita.*

Male. Length 6½ lines. Head and thorax green, the abdomen green, with more or less of a bright carmine lustre. Labrum, mandibles, and the scape in front white; the flagellum of the antennæ, except the two basal joints, fulvous beneath; the clypeus with a central longitudinal carina; the labrum has a central carina and one on each side, which emanates from a small tubercle near the base; the cheeks have a pale pubescence, as has also the thorax beneath, the sides and in front above, as well as the anterior and intermediate tarsi; the scutellum with a deep central depression; the posterior tibiæ and tarsi of a brilliant coppery lustre; the thorax and abdomen closely and finely punctured, the latter of a brilliant coppery lustre beneath; the wings subhyaline.

Hab. Jamaica.

The most highly coloured specimen is described; others have the abdomen green, with a faint coppery tinge towards the apex: intermediate states of coloration also occur.

*4. *Euglossa decorata.*

Female. Length 5½ lines. Head and thorax green, legs and abdomen ferruginous. Head strongly and closely punctured; the clypeus with a central and two lateral longitudinal carinæ; the labrum and mandibles yellowish white, the latter with their margins and apex rufo-piceous; the antennæ ferruginous, with the flagellum dusky above; beneath, thinly clothed with hoary pubescence; the vertex with a little erect fulvous pubescence. Thorax closely and finely punctured above, and clothed with fulvous pubescence, beneath it is hoary; the scutellum, tegulæ, and nervures of the wings ferruginous; the latter flavo-hyaline and iridescent; the basal joint of the tarsi and margins of the posterior tibiæ dark purple; the legs have a thin pale pubescence. Abdomen ferruginous at the base, becoming dark fuscous at the apex; the fourth and fifth segments have their apical margins fasciated with white

pubescence; pale ferruginous beneath, the segments fringed with white pubescence.

Hab. St. Paulo (Brazil).

5. *Euglossa Brullei.*

Euglossa Brullei, St.-Farg. Hym. ii. p. 10, ♀.

Hab. St. Paulo (Amazon).

The male has not been described: it is of the same colour as the female. The only example I have seen has the thorax tinged with green anteriorly; the tegulæ are also green, as is also the upper margin of the posterior tibiæ; the anterior tarsi have the usual pubescent fringe on their inner margin; the face has no pale markings.

6. *Euglossa smaragdina.*

Centris smaragdina, Perty, Del. An. Art. p. 150, tab. xxviii. fig. 13, ♂.

Hab. Minas Geraes.

This species is described as having the head, prothorax, and abdomen at the base of a golden emerald-green, the posterior tibiæ ferruginous and much thickened.

7. *Euglossa pulchra.*

Euglossa pulchra, Smith, Cat. Hym. Ins. *Apidæ*, ii. p. 381, ♀.

Hab. St. Paulo (Amazon); Tapajos.

The male of this species exactly resembles the female in colour; it was taken by Mr. H. W. Bates. Its head is bright golden green, the clypeus tinged with coppery lustre, the thorax, legs, and two basal segments of the abdomen purple-black, the wings subhyaline, the third and four following segments of the abdomen golden green.

8. *Euglossa violacea.*

Euglossa violacea, Blanch. Hist. Nat. Ins. iii. p. 405, ♀.

Hab. Brazil.

9. *Euglossa cærulescens.*

Euglossa cærulescens, St.-Farg. Hym. ii. p. 11, ♂.

Hab. Mexico.

This species has been received from Mexico; St.-Fargeau only describes the male, and did not know the locality of the species. It varies in colour: males, which I have seen, are in some instances green with the abdomen purple, others entirely green with violet-coloured legs; the thorax is thinly

covered anteriorly with fulvous pubescence. The female, of which sex I have only seen a single example, has the face dark blue, the vertex black; the clypeus with a longitudinal sharp carina; the thorax black above, with an obscure purple tint on the scutellum, the legs obscure purple; the abdomen has the first and second segments obscurely purple, the following segments green and covered with short pale fulvous pubescence, the pubescence extends up the sides of the second segment.

10. *Euglossa nigrita.*

Euglossa nigrita, St.-Farg. Hym. ii. p. 14, ♀.
Euglossa analis, St.-Farg. Hym. ii. p. 14, ♂, nec Westw. (1841).

Hab. Cayenne; Para; Santarem; Rio Janeiro.

The female is totally black; the male has the apex of the abdomen covered with ferruginous or fulvous hair.

11. *Euglossa Romandii.*

Euglossa Romandii, Guér. Icon. Règ. Anim. p. 458, ♂.

Hab. Para; Santarem.

The female is coloured like the male, having the head and abdomen golden-green, the thorax and legs purple-black.

LXII.—*On two apparently new Species of* Gobius *from Norway.* By Robert Collett, of Christiania.

Gobius orca, n. sp.

D. 6 | 11. A. 10. V. 6. P. 18. C. 3 | 13 | 3. L. lat. 28.

Body much compressed, the greatest depth being more than half of the length of the head, which is contained thrice and one half in the total (without caudal). Head depressed, broader than high; snout shorter than the eye; lower jaw projecting beyond the upper. Eyes large, very close together, and partly directed upwards, the diameter of the orbits being nearly four tenths of the length of the head. Head and throat scaleless, the scales of the body large. Anal papilla indistinct. The fins elongated; the origin of the anterior dorsal is in the vertical from the root of the pectoral. The interspace between the two dorsal fins is equal to the length of the eye; the first and second spine of the anterior dorsal produced into filaments;

both dorsals much higher than the body; the last rays of the posterior dorsal do not extend to the root of the caudal. The pectoral and ventral fins reach equally far backwards to the vent. The ventral fins have the basal membrane apparently not developed. Body uniform greyish, with numberless brown points, darker between the anal and posterior dorsal and at the root of the caudal; the fins dark brownish grey, an indistinct whitish band at the outer half of the posterior dorsal.

A single specimen was brought up in a dredge by Professor Sars, jun., at Espevar, in the mouth of the Hardangerfjord (59° 35′), from a depth of 80–100 fathoms, in July 1873. Total length 32 millims., to the root of the caudal 26, length of the head 7½, depth of the body 4½.

Gobius scorpioides, n. sp.

D. 6 | 9. A. 8. V. 6. P. 20 (18). C. 6 | 12 | 6. L. lat. 28.

Body compressed, its depth is contained six times in the total (without caudal). Head depressed, broader than high; snout shorter than the eye; lower jaw projecting beyond the upper. The length of the head is contained thrice and one third in the total. Eyes large, close together, the diameter of the orbits being nearly four tenths of the length of the head. Head and throat scaleless; the scales of the body large, deciduous. Teeth in the outer series enlarged. The dorsal fins higher than the body; the last rays of the posterior do not extend to the root of the caudal; the interspace between the dorsals is equal to the length of the eye. The ventral fins have the basal membrane little or not developed. Body with four or five blackish brown cross bands, two extending from the anterior dorsal to the belly, one from the posterior dorsal to the lateral line, the fourth behind the last mentioned fin, and the fifth (less conspicuous) at the root of the caudal. Belly yellowish; head with three or four blackish spots or cross bands; fins blackish, the posterior dorsal with indistinct bands.

Two specimens were brought up in the dredge by Professor Sars, jun., 1872 and 1873, in the fjords of Hardanger and Stavanger (59° 35′), from a depth of 20–60 fathoms. Length of the first 37 millims., to the root of the caudal 30, length of the head 9, depth of the body 5½; length of the second 28.

Christiania, May 10, 1874.

LXIII.—*On a new Species of Megapode.* By R. Bowdler Sharpe, F.L.S., F.Z.S., &c., Senior Assistant, Zoological Department, British Museum.

The Museum is indebted to Dr. Sharpey, F.R.S., for a specimen of a Megapode which was shot by Henry David Cooper, Esq., on the island of Trinkut, in the Nicobar group. I propose to call it

Megapodius trinkutensis, sp. n.

Above olive-brown, many of the feathers rather inclining to clearer and more rufous brown on their margins; wings uniform with back externally, the inner webs of coverts and quills deep brown, the primaries very pale fulvous brown on their outer webs; tail uniform with back; crown of head light bay; lores, cheeks, and region of the eye bare; ear-coverts, throat, sides of neck, and hinder part of latter forming a collar pale creamy fulvous; under surface of body rather lighter olive-brown than the back, greyish on the abdomen, thighs, and under tail-coverts; under wing-coverts olive-brown like the breast, except the greater series, which are greyish like the inner lining of the wing. Total length 15·5 inches, culmen 1·1, wing 9·7, tail 3·5, tarsus 2·45.

Hab. Trinkut Island, Nicobars.

This new species is closely allied to *M. nicobariensis*, as might have been expected; but on examining the excellent account of the latter bird lately published by Mr. Hume ('Stray Feathers,' ii. p. 276), it is evident that the Trinkut bird is distinct. It has none of the "French-grey" tinge on the throat and sides of neck, but, on the contrary, has these parts a pale fulvous colour, forming a collar round the hind neck.

LXIV.—*On the Skeleton of the New-Zealand Pike Whale,* Balænoptera Huttoni (Physalus antarcticus, *Hutton*). By Dr. J. E. Gray, F.R.S. &c.

[Plate XVIII.]

The skeleton of the whale of which Professor Hutton's account and figure are given in the 'Annals' (*ante*, p. 316, Pl. XVI. a), from Otago Head, has arrived at the British Museum. It is in a very perfect state and beautiful condition, wanting only one ear-bone, which Professor Hutton says he will send at the next opportunity.

It proves to be a species of the Pike Whale (*Balænoptera*), the Australian representative of the Pike Whale of Northern Europe, but perfectly distinct from it, and probably smaller than the European species; for though the skeleton is that of a young whale, the bones of the specimen sent are generally well knit, the epiphyses of only a few of the cervical vertebræ are free; the lateral wings of the atlas and the edge of the scapula are imperfectly developed. It differs from the European species in the larger size of the head, the fewer vertebræ, and the longer fingers compared with the length of the forearm.

Professor Hutton gave the name of *Physalus antarcticus*, Gray, to this species, thereby intending the *Balænoptera antarctica* mentioned by me in the 'Zoology of the Erebus and Terror,' p. 51, and founded on some yellowish-white Finner-baleen imported from New Zealand. But this baleen must come from a very much larger species of true Finner; for it is much broader compared with its length. The New-Zealand Finner is not to be confounded with the *Balænoptera antarctica*, Van Beneden (Ostéog. Cét. p. 234), which name he gave to the gigantic *Sibbaldius antarcticus* described by Burmeister from Buenos Ayres (Proc. Zool. Soc. 1865, p. 713, figs. 1 & 2; Gray, Cat. Seals and Whales, p. 381, fig. 87), which Malm has named *Physalus antarcticus*. The bladebone of this species is 6 feet broad and 3 feet high. The bladebone of the Otago Pike Whale is only 15 inches broad and 9 inches high; and it differs from that figured by Burmeister not only in size, but in the glenoid being much more oblong, and in the shape and direction of the coracoid and glenoid processes.

It is necessary to refer this species to the genus *Balænoptera* and give it a new specific name, as *Balænoptera antarctica* is already used by Van Beneden. I therefore propose to call it *Balænoptera Huttoni*.

The genus *Balænoptera* may be divided into two sections, thus:—

* Balænoptera. Vertebræ fifty; cervical vertebræ sometimes ankylosed, with the neural canal broad, trigonal; fingers scarcely the length of the forearm-bone. *B. rostrata*: northern seas.

** Dactylæna. Vertebræ forty-eight; cervical vertebræ quite free, with the neural canal broad, oblong, low; fingers the length of the forearm-bone. *B.* (*D.*) *Huttoni*: Antarctic seas.

Balænoptera Huttoni.

Dorsal fin erect, compressed, about two thirds the entire length from the nose. Skull about one fourth the entire length. Baleen elongate, triangular, much longer than broad. Vertebræ forty-eight; neural canal of cervical vertebræ broad and low, transverse; ribs 11 . 11, first simple-headed. Pectoral fin moderate, the middle finger as long as the forearm-bone.

Physalus antarcticus, Hutton, Ann. & Mag. Nat. Hist. 1874, xiii. p. 316, t. xvi. A (not Gray, 'Voy. Erebus and Terror').

Hab. Southern New Zealand, Otago Head.

The skull is elongate, 46 inches long, 50 inches over the curve, and 22 inches wide in front of the orbits. The back of the brain-cavity slopes forwards from the *foramen magnum* nearly to the nasal bones. The beak is 32 inches long from the back edge of the nasal bones, slightly arched, and gradually tapers from the front of the orbit to the tip; the sides of the maxillary bones are nearly straight or very slightly concave. The intermaxillaries are narrow, rather broader in the middle of their length, flat on the front part, and concave on the sides of the blower.

The skull greatly resembles that of *Balænoptera rostrata*, especially in the form of the intermaxillaries and the concavity at the hinder part of them.

The nasal bones solid; the pair above elongate, triang , nearly twice as long as broad, flat at top behind, and shelving off on each side in front, leaving an angular keeled central ridge, which is square at the top, broader below, 4½ inches long and 3½ inches wide.

The lower jaw is strong, curved, 44 inches long, and has a distinct conical tapering coronoid process.

The palatine bones at the end of the underside of the upper jaw are oblong, four-sided, longer than broad; they are truncated, but rounded on the outer side of the front edge, and united by a straight median suture; they are attached by a large broad laminar suture to the pterygoid bones behind. These bones are much larger and broader than those of the *Rorqual du Cap*, Cuvier, 'Oss. Foss.' v. p. 370, t. xxvi. fig. 3 *b*; and they are much broader and larger than those of *Balænoptera Schlegelii* figured by Van Beneden, 'Ostéogr. Cétacés,' t. xiv. fig. 2.

The palatine bones are generally large in the Mysticetes, and the pterygoid bones are very small and widely separate; but in the New-Zealand Pike Whale they are larger than usual. The development of the palatine bones is one of the characters which separate the whalebone-whales from the

toothed Cetacea (Denticetes). In the porpoise the palatines merely form a band between the maxillæ and the pterygoid bones; but they vary in size in the different genera, being larger in some, as *Platanista*; they are very small, and the pterygoids large in *Hyperoodon* (Cuvier, Oss. Foss. v. t. xxiv. fig. 19, *g* & *h*); and they are large in *Catodon* (Cuvier, Oss. Foss. v. t. xxiv. fig. 1, *m* & *n*), where they approach nearer to the shape of those of the whalebone-whales.

One (the left) ear-bone is attached to the skull, and appears to differ from the ear-bones of *Balænoptera rostrata* figured in the 'Catalogue of Seals and Whales in the British Museum,' p. 191, fig. 56, in being shorter; but it cannot well be seen, as I do not wish to detach it from the skull.

The baleen is elongate, triangular, longer than broad at the base—when dry, horn-coloured, blackish on the straight edge, whitish on the inner hairy margin and at the tips. A blade is 15 inches long, and 2 inches wide at the base; but there are some rather larger.

The vertebræ are 48—cervical 7, dorsal 12 (with eleven pairs of ribs), lumbar 13 (with lateral processes, without any perforation at the base), caudal 16 (with only rudimentary lateral processes or none, and a perforation at base). There are seven chevron bones; but it is not quite certain that they are perfect.

Ribs eleven pairs. The first rib with a single head, and a broad sternal end; the other ribs slender, curved, all similar.

The cervical vertebræ are seven, all free. The atlas with a blunt broad process on each side; the axis thicker, with a keeled, wide, hood-like process above, the lateral processes abbreviated, leaving a broad rounded notch, most probably elongate when complete. The second, third, fourth, and fifth cervical vertebræ have a process from each lower side of the body. The processes of the second, third, and fourth are compressed, rather dilated at the ends, and rather produced at the upper margins of the end; those of the fifth are cylindrical, rather swollen at the ends; and there are only rudimentary ones on the sixth and seventh. The bodies of the vertebræ are oblong, four-sided, broader than high. The neural canals oblong, transverse; of the axis smaller, more rounded; of the other cervical vertebræ wider and lower, nearly as broad as the bodies of the vertebræ, and in this respect very different from the canal of the fifth cervical vertebra of *B. rostrata*, figured in the 'Catalogue of Seals and Whales in the British Museum,' fig. 51.

The sternum broad and expanded in front, and with a short stem behind; the front edge rounded, with a slight

notch in the middle, and with rounded ends. The sternum is 6¼ inches broad, 5 inches long; the hinder part thick, cylindrical, about 2½ inches long, very different from that of *Balænoptera rostrata* figured in the 'Catalogue of Seals and Whales in the British Museum,' p. 110, fig. 12, *c*, more like the sternum of *Balænoptera musculus*, Van Beneden (Ostéogr. Cét. t. xii. fig. 14); but the upper part is more expanded, the central notch rudimentary, and the stem longer and more slender.

The os hyoides is 8½ inches wide and 3 inches long, dilated in the middle, with a notch in the front edge somewhat as in *Balænoptera rostrata* (Ostéogr. Cét. t. xii. fig. 4), but more dilated in the middle, and with a process on each side of the notch, to which is attached a flattened bone. M. van Beneden does not figure any processes to the os hyoides of any of his species in the 'Ostéographie' similar to those found in the skeleton from Otago.

The scapula broad and low, the upper edge being about one third of a circle, with well developed acromion and coracoid processes. The glenoid cavity large, oblong; the coracoid blunt; the acromion process coming from a ridge which extends up the upper margin, elongate and broad. The width 15 inches, the height 9 inches; the glenoid cavity 4½ by 2⅝ inches. The scapula is rather broader and lower, and has a smaller acromion process than that of *B. rostrata* figured by Van Beneden (Ostéogr. Cét. t. xii. fig. 6).

The bones of the fore fin are 28 inches long; the humerus 6 inches, the ulna and radius 10 inches, the longest finger 10 inches. The first finger with three bony joints and one cartilaginous one, the second with seven, the third (longest) with eight, the fourth with four joints.

There were sent with the skeleton a pair of ear-bones of another Finner; but they cannot belong to this skeleton, as the skull has the left one attached, and Professor Hutton informs me that one was unfortunately left behind, but it is on its way to the Museum. The pair of ear-bones sent are very like those of *Megaptera novæ-zelandiæ*, 'Catalogue of Seals and Whales,' p. 128, fig. 20.

EXPLANATION OF PLATE XVIII.

Fig. 1. Nasal bone.
Fig. 2. Cervical vertebræ.
Fig. 3. Os hyoides.
Fig. 4. Sternum.
Fig. 5. Scapula.
Fig. 6. Arm- and finger-bones.

LXV.—*Descriptions of new Lizards from Persia and Baluchistán.* By W. T. Blanford, F.Z.S.

Lacertilia.

Family Agamidæ.

1. *Stellio liratus.*

S. supra fuscus, nigrescente transversim fasciatus, a valde affini *S. melanura* squamis supracaudalibus caudæ basin versus haud carinatis, plica nuchali præsente et forsan squamis carinatis ad medium dorsum majoribus distinguendus. A *Stellio nupto* differt squamarum carinis, ad medium dorsum in lineis parallelis dispositis, ad latera postice divergentibus, ipsis squamis dorsalibus utrinque gradatim diminuentibus, et colli lateribus vix spinosis.

Hab. in Gedrosia (Baluchistán) haud procul a litore.

Only a single specimen captured, measuring 4 inches from snout to anus. Scales round the middle of the body 120 to 130.

2. *Stellio microlepis.*

S. caucasico affinis sed squamis, præsertim in medio dorso, inter humeros, minoribus, et coloribus magis fuscis distinguendus: squamæ circum medium corpus plus quam 200, cum in *S. caucasico* 150–160 duntaxat numerantur.

Hab. in montibus Persiæ meridionalis.

Numerous specimens were obtained.

Family Geckotidæ.

3. *Gymnodactylus brevipes.*

G. affinis *Gymnodactylis geckoidi, caspio, kachhensi*que, dorso tuberculis parvis triquetris, in 10 series longitudinales dispositis ornato; cauda verticillata, annulis singulis tuberculis tribus carinatis longiusculis utrinque armatis, subtus scutis majoribus (nonnullis divisis) induta: squamis ventralibus in serie transversa circum 22; poris inguinalibus 4, femoralibus nullis, membris digitisque brevibus; pede anteriore vix ante oculum, posteriore humerum attingente.

Hab. in Gedrosia (Baluchistán).

Distinguished from allied species by its much shorter limbs and feet, and especially by its short toes.

4. *Gymnodactylus heterocercus.*

G. depressus, capite granulis majusculis superne tecto; dorso tuberculis carinatis triquetris, in series 12 longitudinales dispositis ornato; cauda superne verticillata, annulis singulis tuberculis

tribus majoribus utrinque ad latus instructis, *subtus squamis parvis imbricatis carinatis mucronatis induta*; cruribus supra tuberculis majoribus ornatis, subtus squamis parvis imbricatis carinatis tectis.

Hab. ad Hamadán in Persia occidentali (*Doria*).

The only two specimens of this species which I have seen belong to the Turin Museum, and were brought by the Marquis Giacomo Doria from Hamadán. The keeled imbricate scales beneath the tail and legs serve to distinguish it from all allied forms.

BUNOPUS, gen. nov. (vel subg. *Gymnodactyli*).

Genus inter *Gymnodactylum* et *Stenodactylum* fere medium, cum illo digitis ad latera haud denticulato-fimbriatis, cum hoc scutellis infradigitalibus verrucosis concordat.

5. *Bunopus tuberculatus.*

B. griseus, fusco maculatus atque transfasciatus, tuberculis dorsalibus confertis triquetris, meatum auditorium magnitudine fere æquantibus ornatus; poris inguinalibus circa 7 præditus, scutellis post et inter nares vix majoribus, supralabialibus 10–12; cauda annulata, annulis tuberculatis.

Hab. in Gedrosia Persiaque meridionali frequens.

A *Gymnodactylus* with the transverse scutella beneath the toes studded with tubercles, as in *Stenodactylus*. It, however, wants the fringes to the toes, which are characteristic of the latter genus, and is evidently more nearly allied to the former. It inhabits houses.

6. *Pristurus rupestris.*

P. parvus, dorso squamis æqualibus induto, sine crista; cauda compressa, supra (haud infra) cristata; pupilla rotunda. A *P. flavipunctato*, Rüpp., differt dorso non cristato, cruribus longioribus, scutis infralabialibus 3, nec 5.

Hab. in rupibus insulæ Kharg vel Karrack in sinu Persico, etiam haud procul a Maskat in littore Arabico frequens.

A small species; an adult is only 1·9 inch long.

CERAMODACTYLUS, gen. nov.

Digiti ad latera fimbriati, subtus squamis parvis imbricatis in series obliquas ordinatis obtecti; caput corpusque squamis parvulis undique induta; crura longiuscula; palpebra inferior nulla.

7. *Ceramodactylus Doriæ.*

C. squamis capitis, corporis atque caudæ omnibus, supra subtusque,

parvis, fere æqualibus; cauda corpore breviore; capite magno, parum depresso, oculis magnis, pupilla verticali, meatu auditorio parvo; pede anteriore fere femur, posteriore axillam attingente; poris inguinalibus duobus distantibus: superne fulvus, albo confertim maculatus.

Hab. haud procul a Bandar Abbas juxta litus sinus Persici (*Doria*).

A single specimen was obtained near Bandar Abbas by the Marquis Giacomo Doria, who informs me that it was found on the sand of a torrent-bed. This specimen belongs to the Turin Museum; and I am indebted to the kindness of Count Salvadori for the loan of it and of *Gymnodactylus heterocercus* for description.

A somewhat similar arrangement of imbricate scales beneath the toes is found in the West-African *Stenodactylus caudicinctus*, C. Dum. This is a very different form, having affinities to *Eublepharus*. It is the type of *Psilodactylus*, Gray.

AGAMURA, gen. nov.

Genus novum Geckotidarum propter squamas digitosque ad *Gymnodactylum* accedens, dorso tuberculato, palpebris inferioribus nullis, pupilla verticali, dentibus numerosis æqualibusque, lingua antice brevissime fissa; sed membris elongatis, cauda subcylindrica, valde flexibili, nunquam regenita, *Agamæ* simile.

8. *Agamura cruralis.*

A. grisea fusco transversim fasciata; dorso granulato, granulis vix convexis tuberculisque majoribus frequentibus instructo; membris elongatis, pede posteriore oculum attingente, haud tuberculatis, nisi interdum supra femur; capite brevi, alto, supralabialibus utrinque 12–14, meatu auditorio mediocri; cauda verticillata inermi, subtus serie unica scutorum polygonalium majorum instructa; poris inguinalibus in maribus duobus.

Hab. inter lapides in Gedrosia haud frequens.

This is a remarkable form allied to *Spatalura Carteri*, Gray, and forming with it a distinct subfamily of Geckoes, distinguished by their very different tail, which is very flexible and apparently never reproduced. In *Spatalura* the tail is compressed and fringed above and below.

A second species of *Agamura* is *Gymnodactylus persicus*, C. Dum., very closely allied to *A. cruralis*, but distinguished by having rather shorter limbs, smaller ear-orifice, the upper part of the thigh and front of the tarsus tuberculate, and the rostral shield vertically divided.

LXVI.—*New Observations on* Eozoon canadense. By William B. Carpenter, M.D., LL.D., F.R.S.

[Plate XIX.]

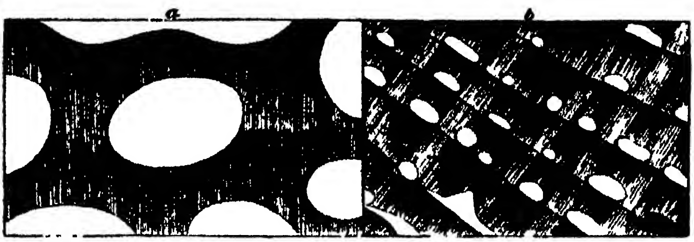
It may be thought that Mr. Carter would have best consulted, not only the interests of science, but his own reputation, by abstaining from any further attempts to disprove the Foraminiferal nature of *Eozoon*, until he had either acquainted himself with the careful descriptions and "fac-simile" representations of its structure given by Dr. Dawson, Prof. T. Rupert Jones, and myself*, or had satisfied himself, by an examination of the specimens which I expressed my readiness to show him, of the fallaciousness of my interpretation. But I make no complaint of his having chosen the opposite course, since his adoption of it has led me to a careful re-examination of the whole subject, with the result of not only removing a difficulty I had myself felt, and of thus strengthening my own conviction, but of enabling me (as I anticipate) to carry that conviction to the mind of every competent judge, who has not so completely made up his mind to a foregone conclusion as to be unable to appreciate the force of the new evidence I have now to produce.

I shall first dispose of the objection which Mr. Carter adduces as *fatal* to the Foraminiferal doctrine, viz. that the supposed nummuline tubuli frequently lie *parallel* to the chamber-walls, instead of *perpendicular* to them—a character which, says Mr. Carter, "is *utterly* incompatible with Foraminiferal structure." This *dictum*, when translated from *Carterese* (p. 278) into English, merely means that it is incompatible with *Mr. Carter's notions* of Foraminiferal structure; to which, as I have already had occasion to show, Nature refuses to bind herself. I fully admit the fact as he states it, and now find a perfectly simple explanation of it in the structure of those very *Nummulites* which Mr. Carter knows so well. In the lower or "lamellar" portion of the Canadian *Eozoon*, the nummuline tubulation (where preserved) always presents—so far as my experience extends—its normal perpendicularity to the surface of the chambers; as shown in Pl. XIX. figs. 1, 2. The arrangement referred to by Mr. Carter presents itself only in that upper or "acervuline" portion, in which, as in many recent Foraminifera, the chamber-

* The "constructed" figure which I introduced for mere convenience of reference, was built-up (as every one of my "constructed" figures has been) from parts which were separately described and figured ten years ago from the actual specimens, for the sake of showing the *relations* between them,—a method used by every Palæontologist.

lets are irregularly piled one on the other (see p. 281, fig. 1); and the *parallelism* of the tubuli to the walls of the chamberlets they adjoin, simply arises from the fact that they are passing-by these, *in that perpendicular course from the chamberlets in which they originate, towards the external surface*, which Mr. Carter himself recognizes as *perfectly normal*. This is shown in the subjoined figure (*a*) traced from a transparent section in my possession—the *precise counterpart to it* (*b*) being shown in those Nummulites which have the "alar

Fig. 1.



Parallel tubulation in acervuline portion of *Eozoon canadense*, showing the course of the tubuli between the irregularly-piled chamberlets.

Parallel tubulation of *Nummulites lævigata*, showing the course of the tubuli between the alar prolongations of successive whorls. After D'Archiac and Haime.

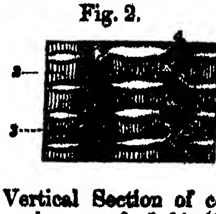
prolongations" of successive whorls prolonged over those which preceded them, so as to be piled one upon another, often dividing themselves into irregular chamberlets. For when these are laid open by vertical section, it continually happens that the tubuli coming off *vertically* from the chambers of an inferior plane, lie *parallel* to the sides of the chambers of the plane above them; so that, if the chambers and tubuli were infiltrated with serpentine, and the calcareous skeleton were removed by acid, the appearance presented would be exactly that figured by Messrs. King and Rowney, which Mr. Carter, with all the weight of his authority, pronounces to be "*utterly* incompatible with Foraminiferal structure."—That I have not evolved this parallelism out of my own consciousness, will be manifest to any one who may take the trouble to refer to the admirable plates of Nummuline structure given by MM. D'Archiac and Haime in their 'Animaux Fossiles du Groupe Nummulitique de l'Inde.' For it is distinctly seen in *every one* of their thin vertical sections of those species in which the "alar prolongations" are conspicuous—as *N. intermedia*,

pl. iii. fig. 4, *e*, *N. garansensis*, pl. iii. fig. 7, *g*, *N. lævigata*, pl. iv. fig. 1, *d*, and *N. obtusa*, pl. vi. fig. 13, *c*,—the figure given above being copied from a portion of the third of those just cited, that I may not be charged with having "constructed" it.

Thus, so far from Mr. Carter's case of *utter incompatibility* proving fatal to the Foraminiferal doctrine of *Eozoon*, a "comparison of the actual specimens" (his own test) gives to that doctrine the additional support of *a very striking conformity*. Speaking for once in *Carterese*, I might say that Mr. Carter has "found a mare's nest."

Professors King and Rowney, also, in their anxiety to put me in the wrong as regards the Foraminiferal relations of *Eozoon*, have only betrayed their own ignorance of Foraminiferal structure, to a degree that must (I should think) shock even their ally Mr. Carter. "We have shown," they say (p. 393), "that the relative position of two superposed acicular layers (an *upper* and an *under* 'nummuline wall'), and the admitted fact of their component aciculæ often passing continuously and without interruption from one 'chamber-cast' to another, to the exclusion of the 'intermediate skeleton,' are *totally incompatible* with the idea of the said 'nummuline layers' having resulted from pseudopodial tubulation." Now, putting aside the *first* part of this statement, which betrays the confusion existing in the minds of its writers between the *true* "nummuline layer," as described by me from transparent sections, and the "acicular layers" of decalcified specimens, which may or may not represent it (see p. 461),—what must be said by Mr. Carter of the *second?* For *he*, of course, knows perfectly well that in the superposed whorls of *Nummulites*, as described by me in 1849, and in the superposed layers of *Orbitoides*, as described by himself in 1861, the pseudopodial tubulation *normally* passes on "continuously and without interruption from one chamber to another, to the exclusion of the 'intermediate skeleton.'" This is represented alike in my original figures of the "Nummuline tubulation" (Quart. Journ. of Geol. Society, 1850), in every one of D'Archiac and Haime's vertical sections of Nummulites, and in Mr. Carter's own sections of *Orbitoides*, of which one is here reproduced.

Fig. 2.



Vertical Section of columns of *Orbitoides dispansa*; 1, column of chambers; 2, vertical tubuli of the test; 3, 4, tubes of intercommunication between the chambers.—After Carter.

It was doubtless the apparent force of the argument whose fallacy I have thus demonstrated, which led Prof. Max Schultze, after reading the paper of Professors King and Rowney, to write to Mr. Barker that it had "made a very great impression" on him, and that "with respect to the 'proper wall' of Carpenter" he was "entirely of their opinion." I have no reason to believe that Prof. Max Schultze ever did see the "proper nummuline wall," such as I shall presently describe and figure it; Professors King and Rowney *certainly have not*, if they can identify it with a film of chrysotile or asbestiform serpentine, forming "an integral portion of the grains and plates of serpentine," and can assert that in its typical condition it occurs in cracks or fissures of the serpentine (p. 393); and they misled Prof. Schultze into the belief that they and I were speaking of the same things. When I sent him the preparations he asked for, I expressed my regret at not being able to supply him with a characteristic specimen of this structure, having given away all the duplicates of it I could spare; and, as it is rarely well-preserved, it is very probable that he did not find it by his own examination of the larger specimens he afterwards received from me and from other sources. At any rate, there is no mention of the "nummuline wall" in his communication to the Wiesbaden Association—his acceptance of *Eozoon* as a Foraminifer entirely resting on the "canal-system," which he had minutely studied*, and as to which *there is no evidence whatever that he had changed his opinion*, as asserted by Professors King and Rowney. Had he lived to see what I shall presently describe, I cannot doubt that he, in common with the numerous Microscopists to whom I have recently shown it, would have accepted the "nummuline wall" without the slightest hesitation.

Before, however, I proceed to describe it, I find myself obliged to notice the following statement made by Professors King and Rowney in the second note to p. 393 of their last paper:—

* Mr. Carter questions the existence of a canal-system in *Polytrema*, referred to by Prof. Schultze, because his own "mounted specimens" do not show it. When he has extended his knowledge of Foraminifera by the careful study of my "Introduction" and of the types minutely described in it, he will find that the development of the "canal-system" is correlated to that of the "intermediate skeleton," and that varietal or even individual differences may occur in this particular. I had never myself seen it in *Planorbulina* (for example), until M. Munier-Chalmas showed it to me, a few weeks since, in a specimen in the Sorbonne Museum. This specimen had grown so closely attached to a Coral, as to have shaped itself on the inequalities of the Coral-surface; and yet its lower or attached side was *as perfectly tubulated* as its upper or free side—a fact which I commend to the consideration of Professors King and Rowney.

"The so-called 'nummuline wall' in Dr. Carpenter's constructed representation, fig. 2, ought not to be represented in the way it is—bounded by two *continuous* lines—as it is an *integral* portion of the grains and plates of serpentine (the so-called 'chamber-casts'), and not a *chemically* differentiated part like the true calcareous wall of certain Foraminifers." I have represented nothing that my specimens do not distinctly show; and the only excuse for such an imputation can be, that those who made it have never seen the *true* "nummuline wall," such as I figured it ten years ago, before a question had been raised as to the organic nature of *Eozoon* (Quart. Journ. Geol. Soc. vol. xxi. plate viii. figs. 3, 4), and such as I now again figure it from a still better specimen in Plate XIX. figs. 1, 2. Professors King and Rowney, merely because they have not met with what I have represented, take upon themselves to deny its existence.

My *true* "nummuline wall" is the representative of that which, in recent Foraminifera, immediately surrounds the chambers (Pl. XIX. fig. 1, *a a*). It is *not* a layer of chrysotile aciculæ; but is a *calcareous* lamella, perforated by minute tubuli, which usually lie straight and parallel, but are often more or less curved. These tubuli, like the chambers and canal-system, are usually filled with serpentine, which has passed into them from the chambers in which they originate; and thus it happens that the original tubulation is generally obscured, being only represented microscopically by the difference in refractive index between the calcareous shelly layer and the serpentine which has filled its tubes,—just as in a specimen of fresh bone or dentine mounted in Canada balsam the tubuli are only represented by the different refractive indices of the matrix and the balsam. But in the specimen of *Eozoon* figured in Pl. XIX. figs. 1, 2, many of the tubuli remain empty; and *they can be distinguished as tubuli under any magnifying-power that the thickness of the covering-glass allows to be used.* Further, they have the somewhat sinuous course of the tubuli of organic structures; and they present, at what was probably a plane of interrupted growth, the sharper flexures which Prof. Owen first pointed out in the tubuli of dentine, and which I described and figured twenty-seven years ago in the hard dentine-like substance of the end of the Crab's claw *.

That the matrix in which these tubules are channelled out is *calcareous*, is shown in this section by the extension into it of the planes of crystalline cleavage (fig. 1, *c c*) of the "cal-

* Report of the British Association for 1847, pl. xx. fig. 81.

careous layer, representing the intermediate skeleton," with which it is continuous. And it is shown also by the effect of dilute acid on any true "nummuline layer" of which the tubules have been filled with serpentine; for it is only *after the removal of the calcareous matrix* that the internal casts of its tubules, remaining as separate aciculæ, present the least resemblance to the chrysotile fibres to which Professors King and Rowney persist in likening them, notwithstanding my repeated assertions that the two things are altogether different. I can show a precisely similar arrangement of vertical aciculæ on the surface of a chamber-cast of a recent *Amphistegina*, and *know* them to be the internal casts of the tubuli of its Nummuline wall. But Professors King and Rowney's argument would make out *these* also to be mere products of mineralization, because they resemble chrysotile-fibres. I am perfectly acquainted with the mineral pseudomorphs to which they refer, and freely admit their resemblance to certain forms of the "acicular layer" left after the decalcification of the "nummuline layer;" but I cannot believe that any microscopist who is familiar either with dentinal or any other form of tubulation, can entertain the slightest doubt that if figs. 2, 3 be correct, the unaltered structure they represent is *organic*. If it be one that any kind of mineralization can produce, I do not see why we are to call Bones and Teeth any thing else than inorganic concretions. The only alternative hypothesis is, that not only Mr. George West and I, but all the Microscopists who have verified our representation, are suffering under "tubulation on the brain;" and this the Galway Professors and Mr. Carter are quite welcome to assert, if they think proper, *when they shall have examined the specimen itself*, which is open to their inspection at any time. At present they are in the position of the opponents of Galileo, who would not look through the telescope which showed the Satellites of Jupiter.

I now pass on to a *second* probative fact of at least equal cogency,—the relation exhibited in the same specimen between the "canal-system" and the tubuli of the "nummuline layer."

In my original description of *Calcarina* (Phil. Trans. 1860)—the type to which, as regards the general distribution of its canal-system and its relation to the intermediate skeleton, *Eozoon* has the closest resemblance—I gave the following account of that relation (p. 554):—"The proper walls of the chambers are uniformly perforated, like those of the chambers of *Rotaliæ*, by foramina of considerable size (averaging above 1 3000th of an inch in diameter); with these the canals of the

supplemental [or intermediate] skeleton do not seem to be directly continuous, for they are of about double the diameter and lie further apart from one another; but immediately round the proper walls of the chambers there seem to be irregular lacunar spaces, into which the foramina open externally, and from which the passages of the canal-system originate." Now, in my "Supplemental Notes on the Structure and Affinities of *Eozoon canadense*" (Proceed. Geol. Soc., Jan. 10, 1866, p. 222), I stated that precisely the same relation is shown to exist in decalcified specimens of *Eozoon*, by the implantation of the dendritic models of the chamber-casts in plates formed by the coalescence of the aciculæ that occupied the tubules of the "proper wall." Having now been fortunate enough to meet with a *transparent section* which exhibits this relation most unmistakably (Plate XIX. fig. 1, *b b*), I fearlessly ask the verdict of any Biologist familiar with microscopic structure, whether any more exact realization *could* be presented of the structure I had described in *Calcarina*,—allowance being of course made for the different scale of the tubulation of the "proper wall," which is here *fine* "nummuline" not *coarse* "rotaline."

There is another feature in the canal-system of this specimen, which, by leading me to a more careful examination of its ordinary distribution, has brought into view what seems to me a new point of difference between the typical canal-system and mineral dendritic ramifications. It will be observed that the principal trunks are here *in the middle* of the calcareous layer, the ramifications extending from them towards each of its surfaces. This, of course, cannot be so clearly brought out in any plane section, as it can be in such decalcified specimens as are represented in figs. 3, 4; in which a set of canals are seen to originate from the ceiling of the chamber *beneath* them, and to converge like the roots of a tree into a stem, from which diverging branches are given off towards the floor of the chamber above. Now, in all dendritic ramifications I have seen (I do not presume to speak with confidence of things I have not seen), the branches go off from a main trunk which originates at once from the source of the infiltration, instead of being formed by the coalescence of roots *. I do not lay any stress on the difference; but this peculiar distribution of the canal-system is not without its significance, in regard to the

* As I was accustomed to see dendrites *made* at a Pottery in Bristol forty years ago, I am not quite so ignorant in regard to them as Professors King and Rowney seem to suppose that I must be, from the fact that I am a Biologist and not a Mineralogist. The process was simply this:—The cylindrical "biscuit" beer-cup (sold for a penny) having been dipped

mode in which it ministered to the deposition of the intermediate skeleton.

The *third* of the additional probative facts I have now to adduce is *the existence of a canal-system in the calcareous lamellæ, anteriorly to the intrusion of any foreign mineral*; as is distinctly proved by the fact stated in my previous "Remarks" (p. 283), that the minuter part of the canalicular system is often not infiltrated with any foreign mineral at all. As I hold this fact to be of cardinal importance, and as I cannot see that it has been met, either by Professors King and Rowney, or by Mr. Carter, in their replies to my previous Remarks, I now present an exact representation (Pl. XIX. fig. 5) of the aspect of such a portion of the canalicular system—showing by its semi-opacity in one part the extent to which the serpentinous infiltration has proceeded, and by its transparence in the rest that the canalization is not the result of any foreign infiltration whatever. These canals (as formerly stated, p. 283) are filled with calcite having the same crystalline axis as that of the matrix—just as is the reticular structure of fossilized skeletons of *Crinoids*, spines of *Cidaris*, &c. It would be just as logical to refuse to that reticulation the character of an organic structure, because it possesses (even in the recent state) a crystalline arrangement, as to say that this canalicular system is not an evidence of the organic origin of the calcareous lamellæ in which it presents itself. "Is it possible," said one of our most distinguished Naturalists to me a few days since, "that it is seriously maintained that these canaliculi do *not* pre-exist?" As I know them to be contained in the section which I long since forwarded to Prof. Rowney, the only conceivable reason for the non-recognition of them, alike by the two Galway Professors and by Mr. Carter, is that they have not used the reduced light, which, through the extreme transparence of the minuter canaliculi, is necessary to bring them into clear view.

I have thus shown:—(1) that the "utter incompatibility" asserted by my opponents to exist between the arrangement of the supposed "nummuline tubulation" of *Eozoon* and true *Nummuline* structure, so far from having any real existence, really furnishes an additional point of conformity; and (2) that three most striking and complete points of conformity exist be-

in its viscid "glaze," and held in an inclined position, a brush dipped in a viscid pigment was brought into contact with it at the proper point; and the pigment ran down into the glaze, first forming a stem, and then spreading out in an arborescent ramification. The success of the operation depends on a very nice adjustment between the viscidities of the two liquids.

tween the structure of the best-preserved specimens of *Eozoon*, and that of the *Nummulites* whose tubulation I described in 1849, and of the *Calcarina* whose tubulation and canal-system I described in 1860. And I leave it to the judgment of those who know the differences between Organic structure and any conceivable results of Physical or Chemical action, whether the appearances represented in Plate XIX., to the minute accuracy of which representation I pledge myself, are compatible with the doctrine that the Canadian Ophite is nothing more than a product of mineralization.

That I have not troubled myself to reply to the reiterated arguments in favour of that doctrine, which have been advanced by Professors King and Rowney on the strength of the occurrence of undoubted results of mineralization in the Canadian Ophite, and of still more marked evidences of the same action in other Ophites, has been simply because these arguments appeared to me, as I thought they must also appear to others, entirely destitute of logical force. Every scientific Palæontologist I have ever been acquainted with has taken the *best* preserved specimens, not the *worst*, as the basis of his reconstructions; and if he should meet with distinct evidence of characteristic organic structure in even a very small fragment of a doubtful form, he would consider the organic origin of that form to be thereby substantiated, whatever might be the evidence of purely mineral arrangement which the greater part of his specimen may present,—since he would regard that arrangement as a probable result of *subsequent* mineralization, by which the original organic structure has been more or less obscured. If this is *not* to be our rule of interpretation, a large part of the Palæontological work of our time must be be thrown aside as worthless. If, for example, Professors King and Rowney were to begin their study of *Nummulites* by the examination of their most mineralized forms, they would deem themselves justified (according to their canons of interpretation) in denying the existence of the tubulation and canalization which I described (in 1849) in the *N. lævigata* preserved almost unaltered in the London Clay of Bracklesham Bay.

My own notions of *Eozoic* structure have been formed on the examination of the Canadian specimens selected by the experienced discrimination of Sir William Logan, as those in which there was *least* appearance of metamorphism; and having found in these what I regarded as unmistakable evidence of an organic structure conformable to the Foraminiferal type, I cannot regard it as any disproof of that conformity,

either to show that the true Eozoic structure has been frequently altered by mineral metamorphism, or to adduce the occurrence of Ophites more or less resembling the *Eozoon* of the Canadian Laurentians at various subsequent Geological epochs. The existence of any number or variety of *purely mineral* Ophites would not disprove the organic origin of the Canadian *Eozoon*—unless it could be shown that some wonderful process of mineralization is competent to construct not only its multiplied alternating lamellæ of Calcite and Serpentine, the dendritic extensions of the latter into the former, and the "acicular layer" of decalcified specimens, but (1) the *pre-existing canalization* of the calcareous lamellæ, (2) the *unfilled nummuline tubulation* of the proper wall of the chambers, and (3) the peculiar *calcarine* relation of the canalization and tubulation, here described and figured from specimens in the highest state of preservation, showing the *least* evidence of any mineral change.

On the other hand, Professors King and Rowney began their studies of Eozoic structure upon the Galway Ophite—a rock which Sir Roderick Murchison described to me at the time as having been so much "tumbled about," that he was not at all sure of its geological position, and which exhibits such obvious evidences of mineralization, with such an entire absence of any vestige of organic structure, that I should never for a moment have thought of crediting it with an organic origin, but for the general resemblance of its Serpentine-grains to those of the "acervuline" portion of the Canadian Eozoon. They pronounced with the most positive certainty upon the Mineral origin of the Canadian *Eozoon*, before they had subjected transparent sections of it to any of that careful comparison with similar sections of recent *Foraminifera*, which had been the basis of Dr. Dawson's original determination, and of my own subsequent confirmation, of its organic structure. And while Prof. Rowney never laid claim to any knowledge of Micro-Palæontology, the accuracy of Prof. King's information in this department of inquiry may be estimated by the fact, that when (about the same time) he made his first acquaintance with the *Orbulina universa* brought up in the 'Porcupine' soundings off the West of Ireland, he forthwith described them as not improbably affording the explanation of the granular concretionary structure of Oolites.—That I did not shrink (as is imputed to me in Profs. King and Rowney's last communication) from meeting them in their own selected field, will appear from the following statement.

When, about five years since, the Galway Professors presented their Memoir on *Eozoon* to the Royal Irish Academy,

the Secretary of that body wrote to me, stating that its Members were desirous of forming their own judgment on the subject, and requesting that I would transmit specimens for their examination. I immediately replied, forwarding the two best duplicates I had to spare, with a request that after they had served their immediate purpose they might be presented to the Museum of Trinity College, Dublin; and I further offered to *go over* to Dublin and *personally exhibit my own selected series of specimens* (which I declined to part with out of my hands) if I could obtain a short leave of absence from my official duties. Not receiving any acknowledgment, either of my specimens or of my proposal, I wrote a second time to the Secretary, and again waited in vain for a reply. I then wrote to the President of the Academy, stating the purport of my previous communications to its Secretary; but as he, too, deemed me unworthy of the honour of an answer, I thought it unadvisable to take any further action in so thankless a matter.

As the readers of these 'Annals' have never had placed before them the *general* evidence in favour of the organic origin of *Eozoon*, adduced by Sir William Logan and Dr. Dawson when they first brought their discovery before the Geological Society nearly ten years ago, I venture to ask their consideration of the following brief summary of the *facts* of this remarkable case, and of the *inferences* which they seem to me to justify.

1. There occurs in the Lower Laurentians of Canada a stratum of "Serpentine Limestone" or "Ophite," extending over several hundred square miles, and impressing the able Geological Surveyors of Canada with its resemblance to a Coral Reef.

2. Most Geologists now accept it as a probability, that the formation of Limestones generally is due, either directly or secondarily, to Animal growth; and the evidence of this doctrine is continually accumulating. The antecedent probability that such was the case with the Laurentian limestone, is increased by the circumstance that beds of Graphite (which every Mineralogist now recognizes as of Vegetable origin) occur in the same formation—that many specimens of the Limestone give forth when struck the overpowering smell of carburetted hydrogen, which is well known to be given off from many beds of Carboniferous Limestone whose organic origin is most distinct—and that so strong a musky odour was emitted from the specimen of which I sent slices to Prof. Rowney and Prof. Schultze, when it was being cut in Mr.

Cuttell's workshop, as to be almost unbearable.—These facts are not advanced as *probative*, but simply as affording *confirmatory probabilities*.

3. The arrangement of the two components of the Canadian Ophite is most remarkable, and extremely significant of some process of *progressive construction*. In the ordinary type there is *a regular alternation of lamellæ of Serpentine and Calcite*, sometimes to the number of *fifty* of each—the thickness of the Calcareous lamellæ being greater below, and progressively diminishing above, whilst that of the Serpentinous presents a singular uniformity throughout. When minutely examined, the Calcareous lamellæ present appearances strongly suggestive to the Micro-Palæontologist of an organic origin, their crystalline cleavage being common to them with almost every calcareous fossil. On the other hand, the Serpentinous lamellæ are seen to be formed by the coalescence of spheroidal segments having a general uniformity of size (see fig. 1, p. 281); while in the upper part of every complete typical specimen, the arrangement of these segments in continuous lamellæ gives place to an irregular piling of them together, the intervening calcareous walls being very thin.

4. Fixing our attention in the first instance on the Calcareous portion of this Ophite (fig. 2, p. 282), we recognize in it a general conformity to the Foraminiferal type,—the lamellated portion showing large "chambers" formed by the coalescence of "chamberlets;" whilst in the "acervuline" portion the chamberlets are isolated, still communicating with each other, however, by apertures through the calcareous septa resembling those of ordinary Foraminifera*.—This transition from a regular plan of growth to the "acervuline" mode is very common in Foraminifera, as must be known to every one who has studied my "Introduction." On the other hand, I have lately come into possession, through the kindness of M. Munier-Chalmas of the Sorbonne Museum, of a new fossil type of Foraminiferal structure belonging to the Orbiculine group, in which a partial coalescence (or subdivision) of chamberlets, like that of the lamellar portion of *Eozoon*, is very distinctly marked, so as to establish precisely the link of connexion which was wanting between the chambers of *Peneroplis* and the completely-divided chamberlets of *Orbiculina*. Thus, then, in the general arrangement of the Calcareous component of the Canadian Ophite, there is a marked conformity to the

* Mr. Carter denies the existence of these passages, simply because he did not find them in the one transparent specimen he examined. He can verify the representation of it given in fig. 2, *b b* (p. 282), whenever it may please him to come and examine my specimens.

Foraminiferal type. And this conformity is equally shown when (as happens in certain localities) the Calcite is replaced by Dolomite. I have frequently met with veins or dykes of the latter mineral running through the ordinary calcareous lamellæ; and there is obviously nothing wonderful in such conversion of the Calcite into Dolomite, either locally or generally, when Magnesia in solution was largely present. But the co-existence of *the same structural arrangement* with *a different mineral composition*, strongly indicates (as Sir William Logan pointed out) the origin of that structure to lie in something else than a mineralizing process.

5. Turning now to the arrangement of the Serpentinous lamellæ, and seeking for a *rationale* of their presence, we find it in the fact first pointed out by Prof. Ehrenberg, then confirmed by Prof. Bailey (who first showed it to be true of existing types), and verified by Prof. Rupert Jones, Mr. W. K. Parker, and myself, that the cavities of *Foraminifera* become occupied, without any process that can be likened to "infiltration" (since it takes place on the ordinary sea-bottom), by Glaucite or other silicates; so that when their calcareous shells are dissolved away by dilute acid, perfect internal casts of their chambers are left. That this is the origin of the *green-sands* which occur in various Geological formations, from the Silurian upwards, is the well-known doctrine of Prof. Ehrenberg, which is based on the striking conformity between the forms of the particles of these sands and the chambers of known Foraminifera. And by that fundamental rule of Geological interpretation, which requires us to explain every thing that we *can* so explain by reference to changes now going on, I hold myself fully justified in contending that the same process—*whatever may be its nature*—which is filling the cavities of existing Foraminifera with siliceous compounds, and which can be traced backwards as far as the Silurian epoch, may fairly be accepted as the *rationale* of the presence of the regular lamellæ and acervuline segments of Serpentine in the Canadian Ophite, its calcareous interstructure having a close conformity to the Foraminiferal type. And here, again, the probability is strengthened by the fact that *the same structure* shows itself, alike in recent and fossil Foraminifera, *with different minerals*. My own recent specimens show it with at least two silicates, a green and an ochreous; and so, as Sir William Logan tells us, the chambers of *Eozoon* may be occupied with pyroxene or loganite, instead of with serpentine—the alternation of *calcareous* with *siliceous* lamellæ, however, being always preserved.

6. The presence of Serpentine, however, is not limited to

the lamellæ; for it penetrates the Calcareous layers, exactly in the same manner that the Silicates which occupy the chamber-cavities of existing Foraminifera penetrate the walls of those cavities, extending into the canal-system of their "intermediate skeleton," and even filling the minute tubuli of their "proper walls,"—so as, when the calcareous skeleton has been dissolved away, to afford the most perfect models, not only of the sarcodic segments which occupied the chambers, but also of their extensions into the canal-system, and even of their minute pseudopodial threads. Now to all this I can show *the most precise parallel* in the Canadian *Eozoon*—even to those departures from the ordinary parallelism of the tubules, which I described in certain varieties of *Operculina* (Phil. Trans. 1859, p. 24). And I am fully justified, therefore, by the accepted rules of Palæontological interpretation, in asserting that whatever exercise of "Nature's cunning" does this work on our present sea-bottom, was adequate to do it in the Laurentian period. The explanation which I suggested, that it is due to a process of chemical "substitution" (the progressive decomposition of the sarcode-body producing a precipitation of silicates from sea-water, which replace the sarcode, particle by particle), however "unscientific" in the eyes of Professors King and Rowney, has approved itself to Chemical and Palæontological authorities of considerably higher standing than the Galway Professors, as the only one by which the silicification of fossil wood, and the silicification of the animal substance of recent Corals (described by Dr. Duncan as even now going on), can be accounted for. On the other hand, Professors King and Rowney, to whom I sent, about three years ago, an exquisite little internal cast (in glauconite?) of *Polystomella*, from Captain Spratt's dredgings in the Ægean, with a request that they would give me their opinion of the process by which it was produced, replied that they considered it to be composed of *mud*; and though I have recently invited them to reconsider this opinion, they have not in any way qualified it. Now let these casts, for the sake of argument, be supposed to have been formed by the infiltration of mud, then a like infiltration would equally account for the production of the deposit in the chambers, canal-system, and nummuline tubules of *Eozoon*, which is *precisely paralleled* by that of many fossil and existing Foraminifera in regard to its mineral condition—as my specimens show.

My contention is, therefore, that the hypothesis of *the Foraminiferal origin of Eozoon canadense* entirely accords with the features alike of the *general* and of the *minute* structure of

the *best-preserved* specimens of this body, and that it is the *only* hypothesis which fits all the facts of the case; whilst the hypothesis of *subsequent* metamorphic change, which has every probability to recommend it, fully accounts for all the appearances on which the Anti-Eozoonists rely as evidence of its Mineral origin, which, in the face of the new evidence I have now adduced, is to my own mind utterly "unthinkable." I do not attempt, however, by dint of hammering-in, to impose my own (doubtless) prejudiced conclusion upon the minds of others, but have endeavoured to place before them the *facts* of the case in such a form as may help them to form their own judgment in regard to them.

Until these facts shall have been disproved by the examination of the specimens which I am ready to submit to any or all of my opponents, I must claim to withdraw from a controversy which cannot be carried further to any advantage without a "comparison of actual specimens." For whilst I admit to the full every evidence of Mineralization adduced by Professors King and Rowney, neither they nor Mr. Carter admit the evidence of Organic structure which they have *not* seen, but which I have expressed my willingness to place before them, with the parallelisms presented by recent Foraminifera.

I am endeavouring to engage my Canadian associates in the preparation of a joint Monograph on *Eozoon canadense,* to be offered to the Palæontographical Society—with a request that before determining either to accept or to decline it, the Council will appoint a Committee of "experts," qualified by their knowledge of Micro-Palæontology and Micro-Mineralogy to judge whether what we hold to be Organic structure can be possibly regarded as the product of any kind of Physical or Chemical action.

EXPLANATION OF PLATE XIX.

Fig. 1. Vertical Section of a portion of one of the calcareous lamellæ of *Eozoon canadense*, showing the tubular "nummuline layer" *a a*, the "intermediate skeleton" *c c*, and the relations of the origins of the canals, *b b*, to the tubuli of the nummuline layer, the flexures of which are seen along the line *a' a'*: 100 diameters.

Fig. 2. Vertical Section of a portion of the "nummuline layer" *a a*, under a higher magnifying-power, showing its distinct tubulation, with sharp flexures along the line *a' a'*: 250 diameters.

Figs. 3, 4. Internal Casts of Canal-system, showing what appears to be its typical mode of distribution: 35 and 15 diameters.

Fig. 5. Transparent Section of a portion of the Canal-system, showing an only partial filling of the canals: 100 diameters.

MISCELLANEOUS.

Observations on the Spermatophores of the Decapod Crustacea. By M. Brocchi.

In 1842 M. Milne-Edwards published, in the 'Annales des Sciences Naturelles' (2e série, tome xviii. p. 331), a memoir on the singular bodies met with in the Cephalopoda, and noticed by Cuvier under the name of *machines* or *animalcules de Needham*. He demonstrated the true nature of these bodies, showing that they were peculiar receptacles destined to contain the seminal fluid, and he gave them the name of *spermatophores*.

These spermatophores have since been indicated in several Invertebrata. They have been met with, 1st, in insects, M. Lespés having described this mode of fecundation in the cricket; 2nd, in certain worms, such as *Clepsine* and *Nephelis*; and, 3rd, in some of the lower Crustacea, spermatophores having been seen and figured by Jurine and Muller in *Cyclops Castor* (*Diaptomus Castor*). However, the true nature of these bodies was only determined by M. von Siebold. Similar receptacles have been observed in others of the lower Crustacea; but, as far as I know, they have never been indicated among the Decapods.

Now, in investigating the anatomy of some Macrura, I have found very distinct tubes in the interior of the penis of the males. The existence of these seemed to be in relation with the state of functional activity of the male genital organs, and to coincide solely with the period of fecundation.

I now believe that I am justified in regarding these tubes as true spermatophores. In fact, in dissecting some male lobsters, I have lately found, in the interior of the penis in these animals, a perfectly distinct tube capable of isolation from the walls of the organ. This tube was situated in the subterminal part of the penis and was of a yellowish-white colour. On placing it under the microscope I distinguished in it clearly a structureless envelope and contents formed by spermatic corpuscles. The latter were very distinct, perfectly recognizable, and in all respects conformable to the figures given by M. Kölliker. Here, therefore, we have in a Decapod a tube containing spermatic corpuscles—that is to say, a true spermatophore.

In his 'Leçons sur l'Anatomie et la Physiologie comparée,' M. Milne-Edwards noticed the existence of a rolled-up tube in the penis of the spiny lobster (*Palinurus*). "In the spiny lobster," he says (tome ix. p. 255), "the subterminal portion of the ejaculatory canal is much dilated, and contains in its interior a tube very much twisted upon itself." Nevertheless the learned Professor does not pronounce an opinion as to the nature of this tube. I may add that M. Alphonse Milne-Edwards was unable to detect the presence of spermatic corpuscles in it. It seems to me that this tube is very probably of the same nature as that observed in the lobster. I must remark also that M. Milne-Edwards had, as it were, foreseen the existence of spermatophores in the higher Crustacea. Thus, in the work which I have already quoted (tome ix. p. 258), he says:—"While investigating the Crustacea of the coast of Brittany in 1827, I found a

female *Cancer pagurus* which had copulated a little while before, and bore, buried in each of its copulatory pouches, a white, cylindrical, soft body, which appeared to me to be the terminal portion of the membranous penis of the male separated from the rest of the sexual organs of the latter. I regret that I have not had the opportunity of repeating this observation, *since my attention has been directed to the spermatophores*; for it is possible that the sort of stopper in question left in the vulva may have been a body of that nature rather than a fragment of a penis."

In dissecting a female *Maia squinado*, I found in its copulatory pouches bodies analogous to those indicated by M. Milne-Edwards. The histological examination of these bodies proved that they could not be regarded as fragments of a penis. In fact they showed no trace of organized tissues. It is therefore possible that they must be regarded as remains of the spermatophores of the male. However, as I have not hitherto had the opportunity of observing spermatophores in the Brachyurous Crustacea, I shall not venture to speak decidedly upon this point.—*Comptes Rendus*, March 23, 1874, p. 855.

On the Felis euptilura *from Shanghai, in the British Museum.* By Dr. J. E. Gray, F.R.S. &c.

The British Museum has received from Mr. Webb, through John Russell Reeves, Esq., a wild cat from Shanghai. It has the colour and much of the spotting of the *Felis rubiginosa* from Western India; but it is quite different from that long-headed, long-tailed cat in being a short-headed, short-tailed animal, and in the short skull having the incomplete orbits of the true cats, instead of being long and with the complete orbits of *Viverriceps rubiginosa*.

This cat has all the characters of the smaller spotted Asiatic cats with short spotted tails, on which I published a paper in the 'Annals' for January 1874 (xiii. p. 55).

I am inclined to regard it as a perfect specimen of the *Felis euptilura*, described by Mr. Elliot and figured by Mr. Wolf, P. Z. S. 1871, p. 761, t. lxxvi., from a very bad skin, now in the British Museum, supposed to have come from Siberia.

The possession of a perfect skin and skull of this confirms it as a distinct species. The specimen in the Museum chiefly differs from Mr. Wolf's figure in the streaks on the crown and nape not being quite so wide, and in the tail being rather longer and more cylindrical, which is easily explained when we consider the very bad state in which the skin figured by Mr. Wolf was.

The skull has very large, prominent, swollen, compressed bullæ to the ears, and a large deep subcircular cavity at the inner side of the hinder part of the flesh-tooth and the small tubercular grinder.

On the Amount of Pressure in the Sap of Plants. By Prof. W. S. Clarke, of Amherst.

It only remains to state in a few words the results obtained by the application of mercurial gauges to the sugar-maple, the black birch, and the grape-vine. Observations were made on one or more

gauges several times daily, and occasionally every hour of the day and night, from the 1st of April to the 20th of July.

A gauge was attached to a sugar-maple, March 31st, which was three days after the maximum flow of sap for this species, so that further observations are required earlier in the season to complete the record and determine with certainty the maximum pressure which it exhibits in the spring. Of the record made, the following facts are specially interesting: first the mercury was subject to constant and singular oscillations, standing usually in the morning below zero, so that there was indicated a powerful suction into the tree, and rising rapidly with the sun until the outward pressure was sufficient to sustain a column of water many feet in height. Thus at 7 A.M., April 21st, there was a suction into the tree sufficient to raise a column of water 25·90 feet. As soon as the morning sun began to shine on the tree the mercury suddenly began to rise, so that at 9.15 A.M. the pressure outward was enough to sustain a column of water 18·47 feet high, a change represented by more than 44 feet of water. On the morning of April 22nd the change was still greater, requiring for its representation 47·42 feet of water. These extraordinary fluctuations were not attended by any peculiar state of the weather, and happened twelve days before there were any indications of growth to be detected in the buds. These observations are believed to be quite new, and as yet inexplicable, but will receive further attention another spring.

The maximum pressure of the sap for the season was observed at 10 A.M., April 11th, and was equal to sustaining a column of water 31·73 feet high. This was an excellent sap day, considering the lateness of the season. There was noticed a general correspondence between the flow of sap in other maples and the pressure on the gauge.

After April 29th the mercury remained constantly below zero, day and night. During the month of May there was a uniform suction equal to about 8 feet of water; and the unaccountable feature of this fact is, that, though apparently produced by exhalation from the expanding leaves, it remained the same, day and night, for several weeks. In June the suction gradually lessened, and finally disappeared, the mercury standing steadily at zero.

On the 20th of April two gauges were attached to a large black birch—one at the ground, and the other 30 feet higher. The next morning at six o'clock the lower gauge indicated the astonishing pressure of 56·65 feet of water, and the upper one of 26·74 feet. The difference between the indications of the two gauges was thus 29·91 feet, while the actual distance between them was 30·20 feet, so that it corresponded almost exactly as if they were connected by a tube. In order to learn whether the same principle would prevail if the upper gauge was moved, it was raised 12 feet higher. The same correspondence continued through nearly all the observations of the season, notwithstanding the gauges were separated by 42·20 feet of close-grained birch-wood.

At 12.30 P.M., April 21st, a hole was bored into the tree on the side opposite to the lower gauge, and at the same level. Both

gauges at once began to show diminished pressure, while sap issued freely from the orifice. In fifteen minutes, one pound of sap having escaped, it was found that both gauges had fallen equal to 19·27 feet of water. Upon closing the hole the gauges rose in ten minutes to their previous level, showing that the rootlets had reabsorbed in that brief period the sap which had escaped from the tree, notwithstanding the enormous pressure already existing.

A stopcock having been inserted into the hole opposite the lower gauge, it was found that the communication between it and the two gauges was almost instantaneous, which appears to prove that the tree was entirely filled with sap, exerting its pressure in all directions as freely as if standing in a cylindrical vessel more than 60 feet in height, as indicated by the lower gauge. The sap-pressure continued to increase until, on the 11th day of May, it represented a column of water 84·77 feet in height, which is believed to be the highest pressure of vegetable sap ever recorded.

The buds of the birch now began to expand, the pressure of the sap to diminish, and the oscillations of the mercury to become more decided and regular than before. The upper gauge ceased to vary May 14th, remaining stationary at zero. The lower one declined slowly and varied greatly, but did not fall below zero until May 18th. On May 27th it also became stationary at zero. The suction manifested by the birch was very little, never exceeding 9 feet of water, and continued only for a few days.

To determine, if possible, whether any other force than the vital action of the roots was necessary to produce the extraordinary phenomena described, a gauge was attached to the root of a black birch tree, as follows. The tree stood in moist ground at the foot of the south slope of a ravine, in such a situation that the earth around it was shaded by the overhanging bank from the sun; a root was then followed from the trunk to the distance of 10 feet, where it was carefully cut off 1 foot below the surface, and a piece removed from between the cut and the tree; the end of the root thus entirely detached from the tree, and lying in a horizontal position at the depth of 1 foot, in the cold damp earth, unreached by the sunshine, and for the most part unaffected by the temperature of the atmosphere, measured about 1 inch in diameter: to this was carefully adjusted a mercurial gauge, April 26th. The pressure at once became evident, and rose constantly with very slight fluctuations, until at noon on the 30th of April it had attained the unequalled height of 85·80 feet of water. This wonderful result showed that the absorbing-power of living birch-rootlets, without the aid of any of the numerous helps imposed upon them by ingenious philosophers, such as exhalation, capillarity, oscillation, dilatation, contraction, &c., was quite sufficient to account for the most essential of the curious phenomena connected with the circulation of sap. Unfortunately, in an attempt to increase the capacity of the gauge, the bark of the root was injured, and this most interesting experiment terminated. There can be little doubt that future trials, carefully conducted with suitable apparatus, will achieve even more marvellous results.

The original experiment of applying a mercurial gauge to the grape-vine, first tried by the Rev. Stephen Hales, of England, one hundred and fifty years ago, was repeated May 9th, and a pressure of 49·52 feet of water obtained May 24th. This is 6½ feet higher than was observed by Hales. The peculiar features of the pressure of the vine-sap are:—its lateness in the season; its apparent independence of the weather; its uniform and moderate rise, day and night, to its maximum; its very gradual decline to zero without any marked oscillations; and its constant and almost unvarying suction of from 4·5 to 6·5 feet of water, manifested from June 20th to July 20th, when the observations ceased.—*From the Eleventh Annual Report of the Massachusetts Agricultural College*, January 1874.

The Bogotá Cat (Felis pardinoides, *Gray*). By Dr. J. E. Gray, F.R.S. &c.

In the 'Annals' for 1874, xiii. p. 51, I gave the reasons for differing from Mr. Elliot's opinion that the cat I named *Felis pardinoides* in the British Museum, received from the Zoological Society as coming from India, was the same as *Felis Geoffroyi*. At the same time I observed, "the Indian habitat has not been confirmed; and the species has a very South-American aspect."

The British Museum has received, from Mr. Edward Gerrard, a cat from Bogotá that I have no doubt is the same species as the typical specimen of *Felis pardinoides*; but it differs from it in being a nearly adult specimen, as is proved by the examination of the skull; and it has a more fulvous tint, and the fur is softer; but this may only depend upon the age and season in which it was killed.

This species of South-American spotted cat has the small head and much the character of *Felis macroura*; but the tail is rather tapering and not so long; instead of having the few broad black rings of that species, it has a larger number of narrow black rings, which are interrupted on the lower side, and these rings on the hinder half of the tail are broader and more distinct than those of the basal half. The spots on the body are much more numerous; and those on the hinder parts of the sides are pale, surrounded behind with an imperfect ring of small black spots.

The Habitat of Pelargopsis gigantea.

To the Editors of the Annals and Magazine of Natural History.

21 Opernring, 4. Stock,
Vienna, 23/5/74.

Dear Sirs,—In the note on the "Habitat of *Pelargopsis gigantea*" in your Journal (May 1874), line 6 of the text, is a misprint in the fifth word. It must be "Joló," and *not* "Toló."

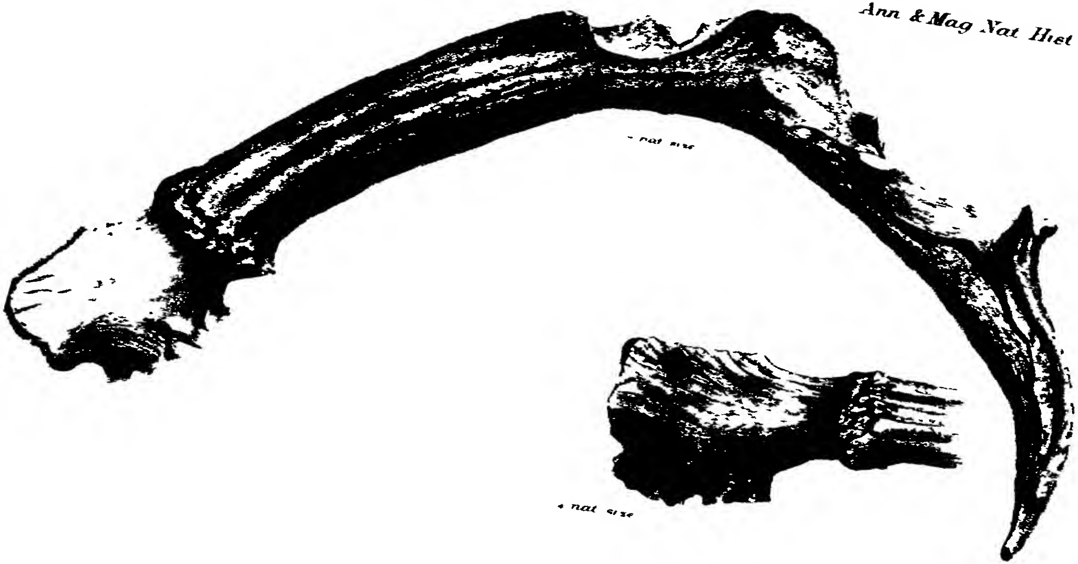
You will oblige me by rectifying this in your next number, as this misprint is disagreeable in a note wherein I correct the statement of another.

Yours very truly,
A. B. Meyer.

INDEX TO VOL. XIII.

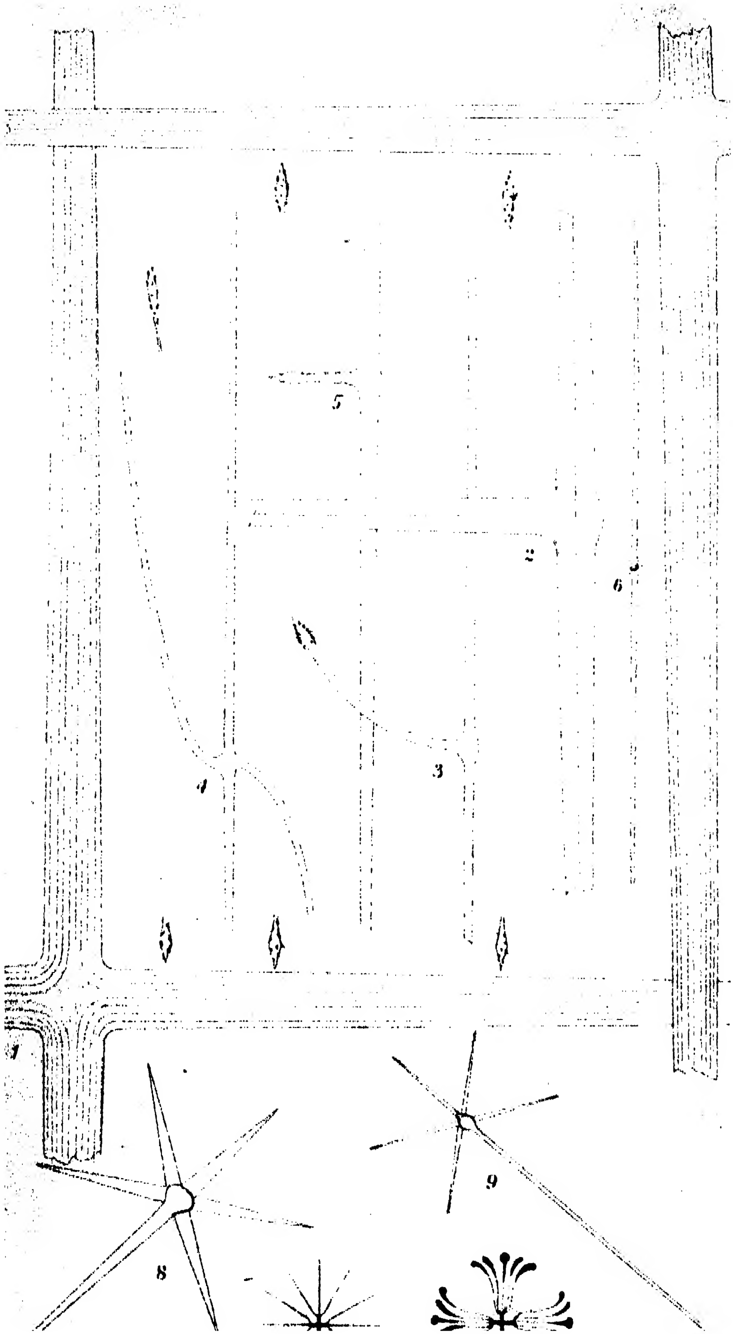
END OF THE THIRTEENTH VOLUME.

PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.

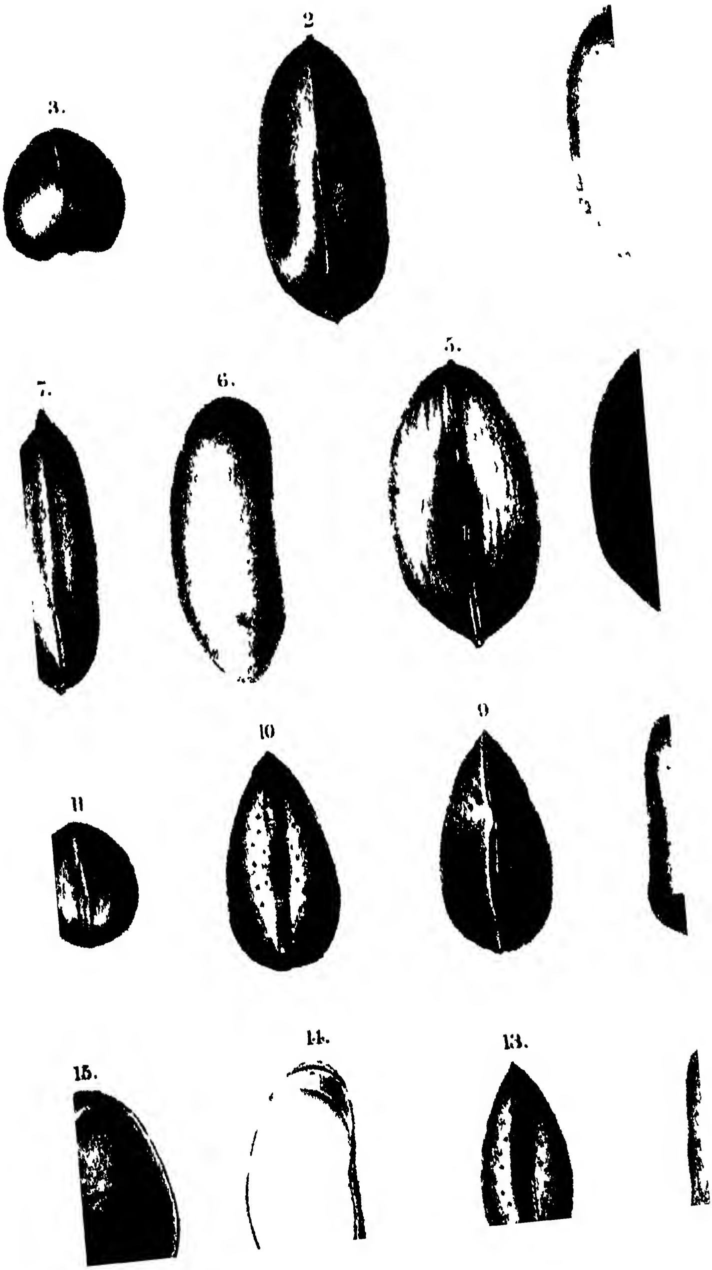


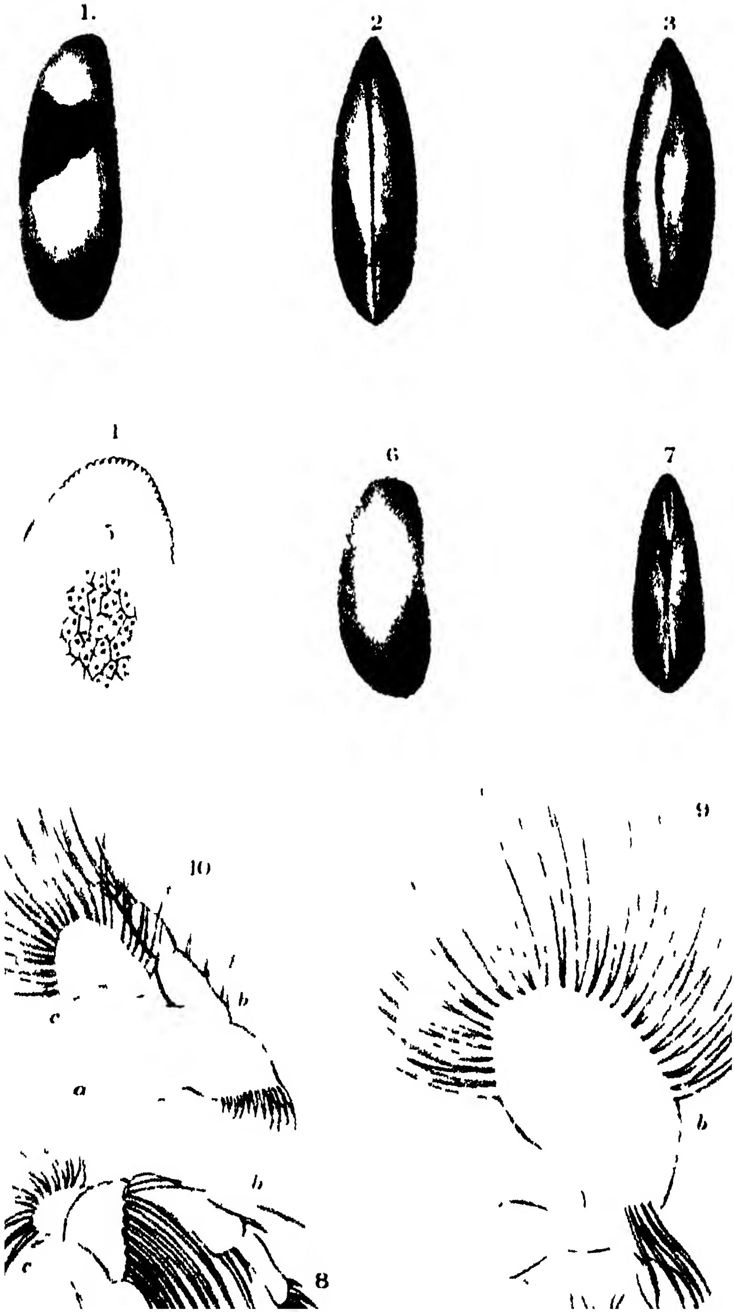
nat size

nat size



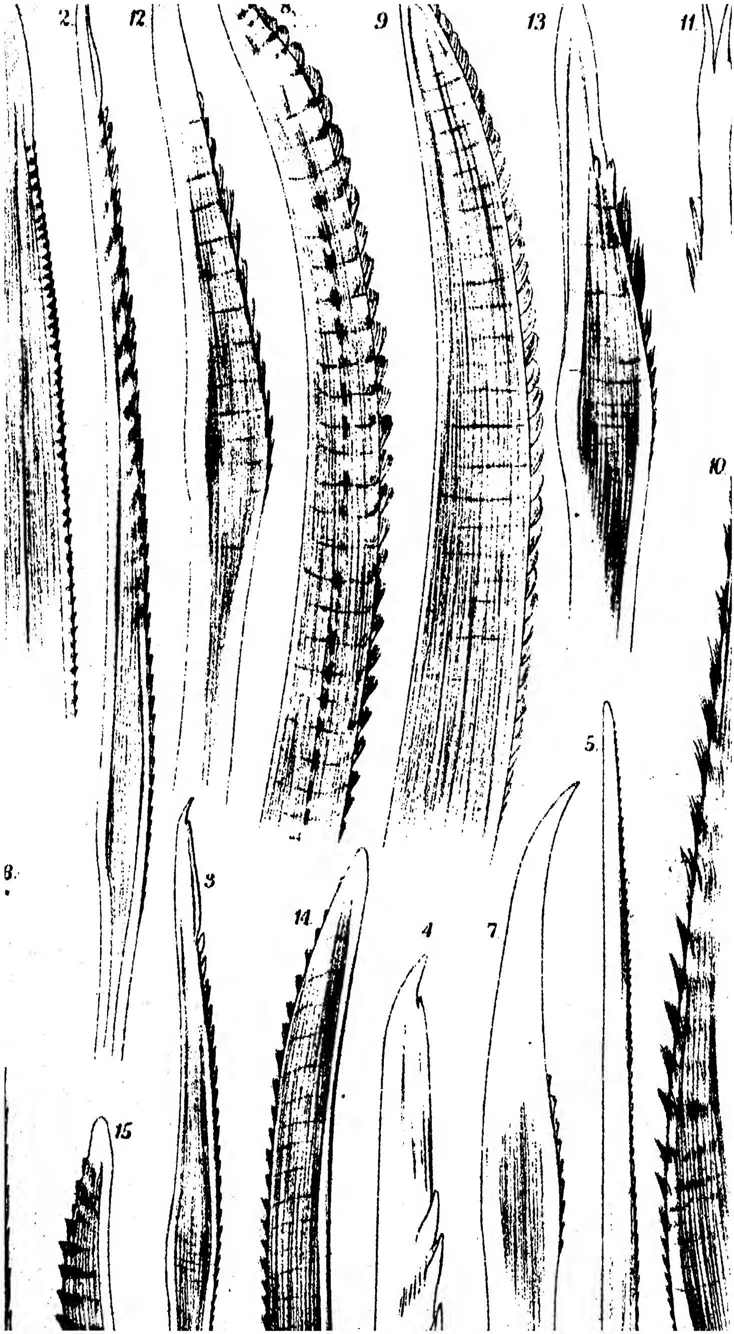
5
2
6
3
4
1
9
8


2
3.
7.
6.
5.
10
9
11
14.
13.
15.

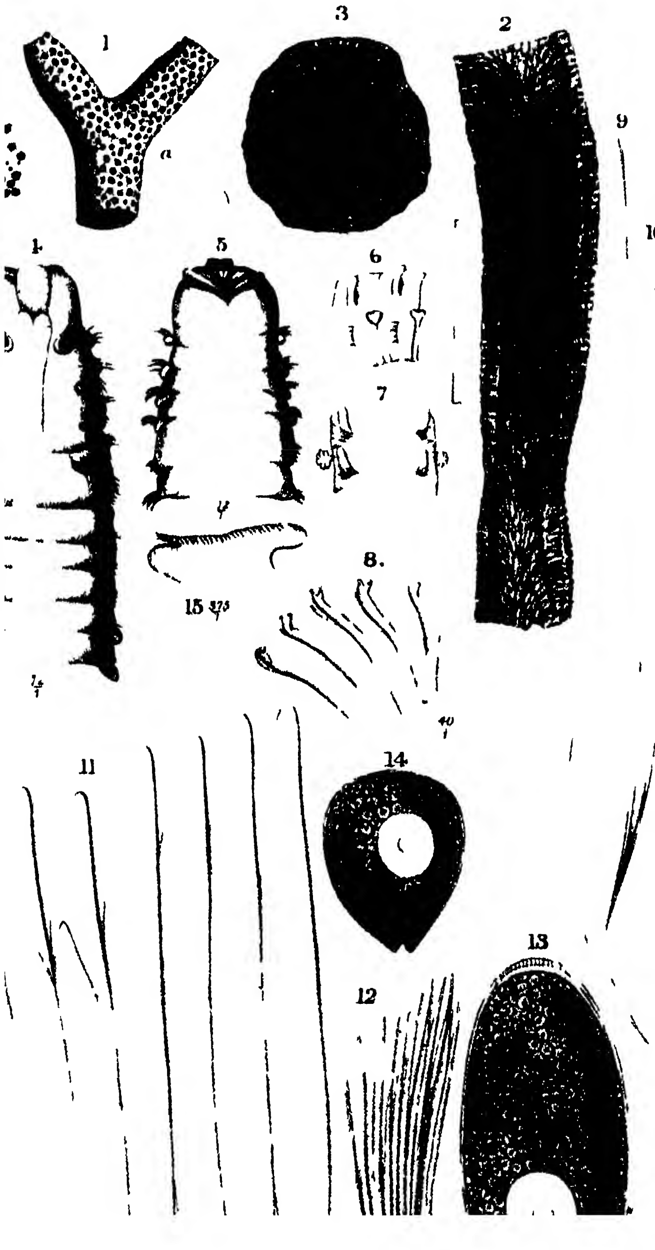

1.
2
3
6
7
10
a
b
c
9
b
8

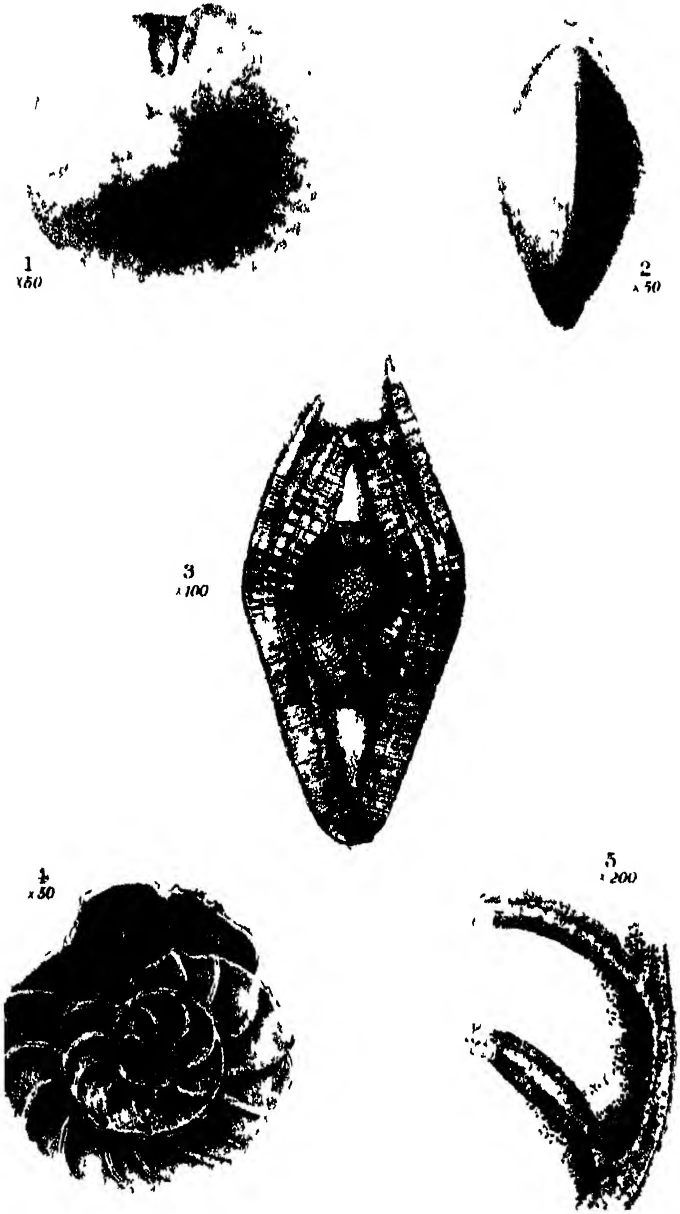
2.
5
1.
3.
6.
4
7.
8.
9.
10.

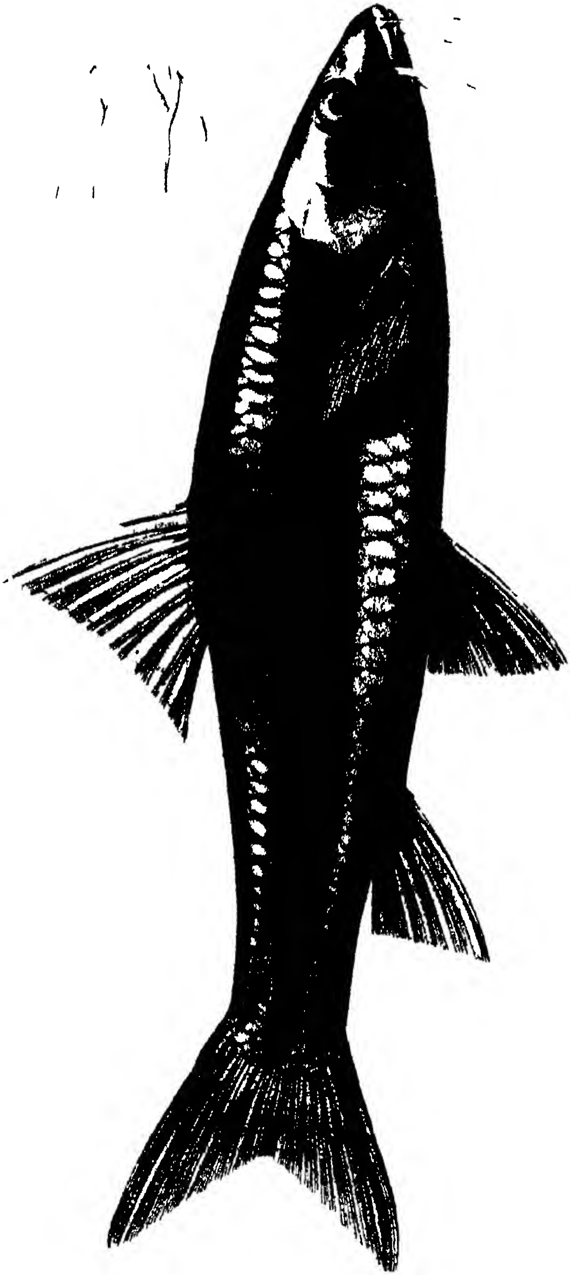

11
2a
21
22


2.
12
8.
9
13
11.
10
5.
6.
3
14
4
7.
15


1
2
3
5
14
8
10
11
6
12
7
13

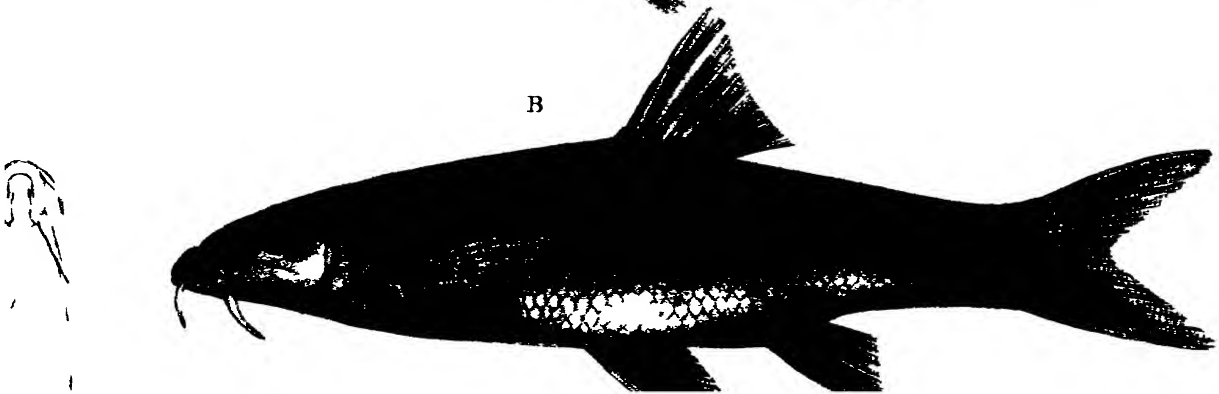

1
a
2
3
4
5
6
7
8.
9
10
11
12
13
14
15

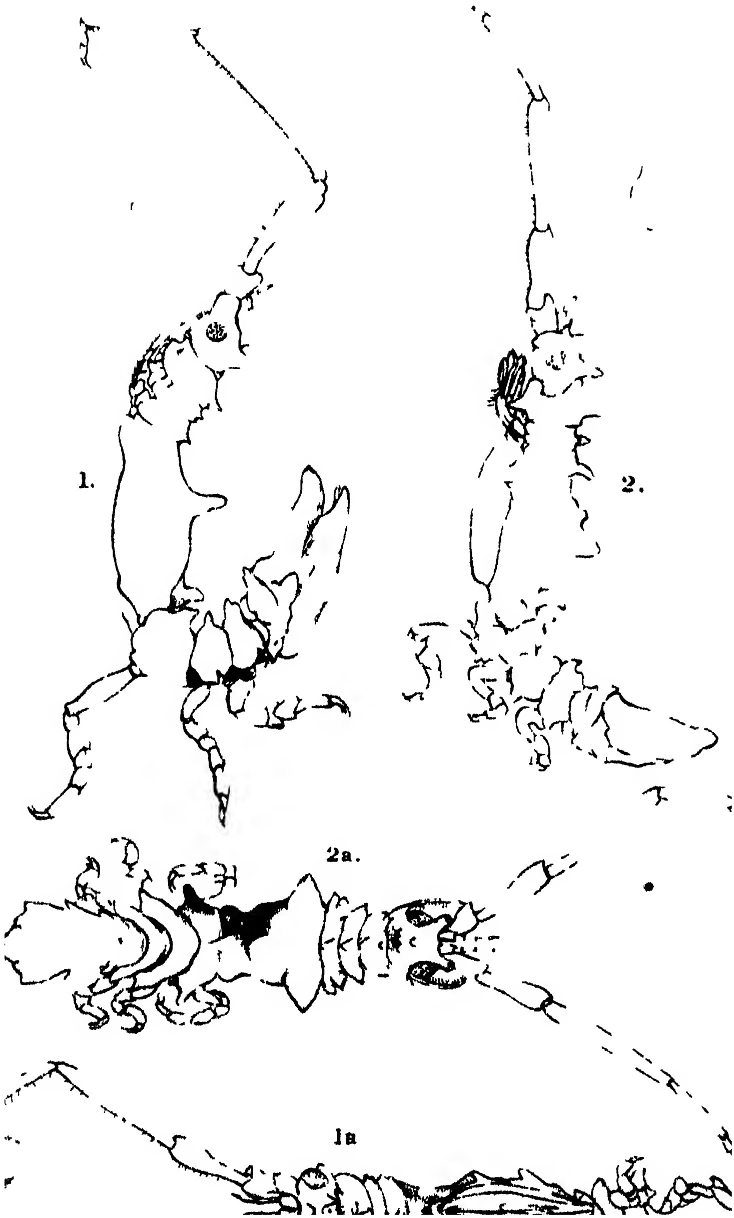

1
×50
2
×50
3
×100
4
×50
5
×200

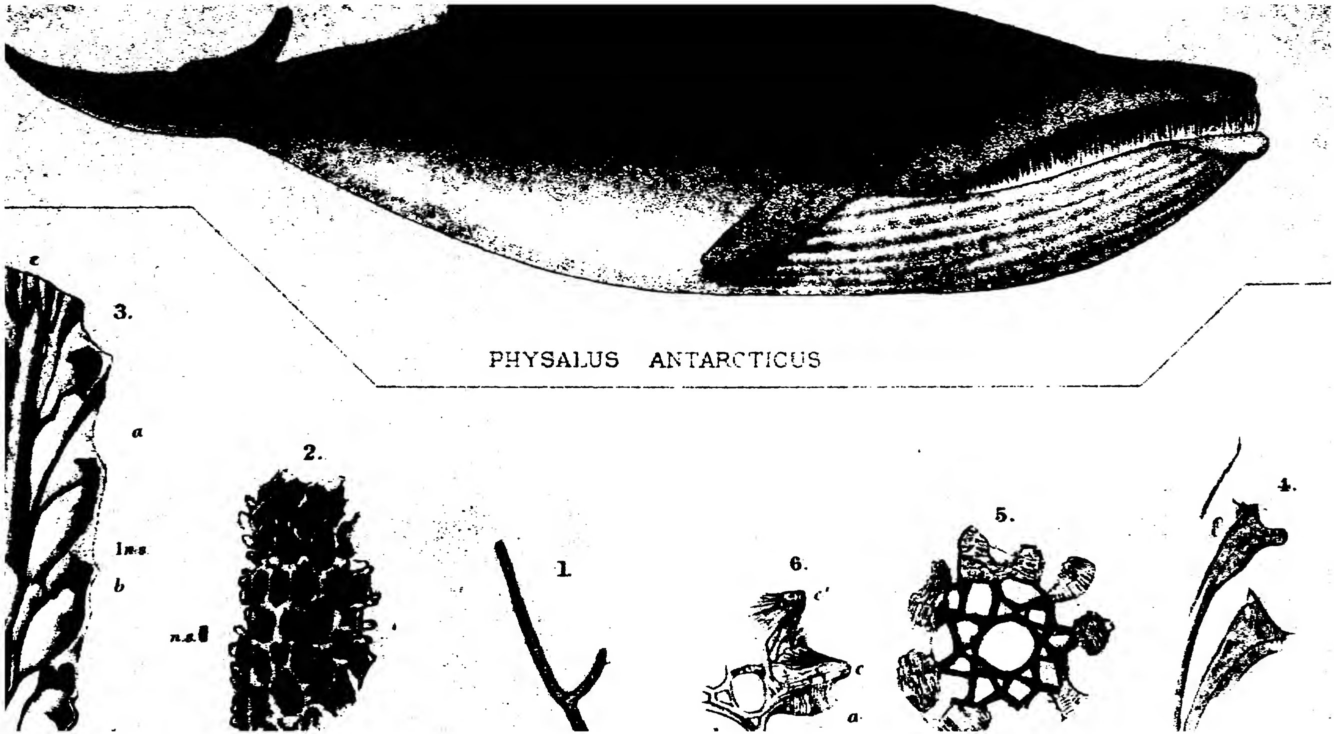


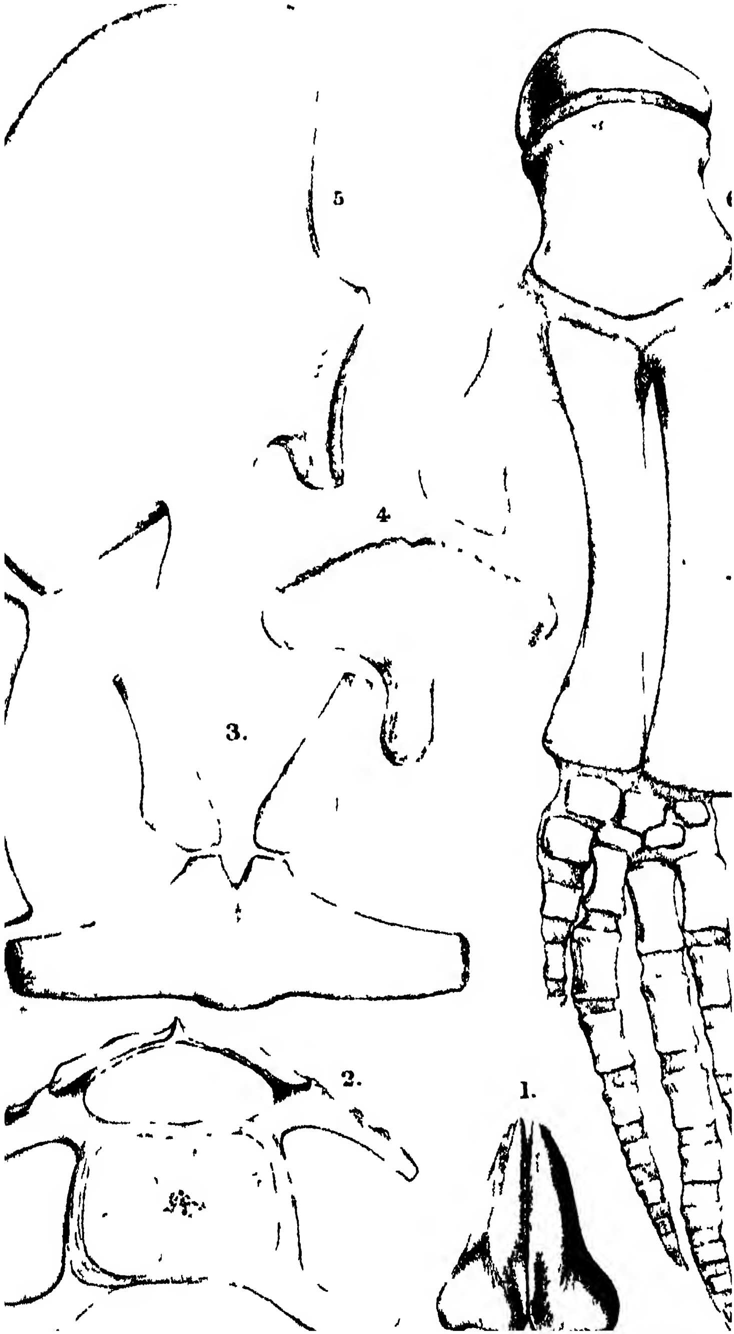
A

B




1.
2.
2a.
1a


PHYSALUS ANTARCTICUS
1.
2.
3.
4.
5.
6.
a
b
c
lm.s
n.s.8
f
c'


5
4
3.
2.
1.

1.

2

3

4

5